HEALTH

BLOUNT

FIGURE 1.—THE SOWER.

By Albin Polasek, Moravia.
(Courtesy of The Art Institute, Chicago.)

HEALTH

PUBLIC AND PERSONAL

BY

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PREFACE

This book aims to promote good health in individuals and in communities. To keep ourselves healthy in all situations of our complicated society to-day requires a clear understanding of the normal activities of the human body. For this reason the book starts with a brief explanation of the working of the vital machine.

The functions of the body are then taken up in greater detail and are related to the life of the community. Rules of conduct for healthful living are developed and applied, with special emphasis on the reasons for these rules. Ancient traditions of doubtful value are discarded and all precepts are modern and scientific.

The topics are made as practical and interesting as possible, not only by simple, common-sense treatment, but by copious illustrations and searching questionnaires. These latter are put, not at the ends of chapters, but after each topic, so as to assure a mastery of the subject in hand, before the pupil proceeds.

Every effort has been made to furnish material which will enable the pupil to safeguard his own and the community's health; yet the importance of the physician is recognized and consultation with him is urged in all but the very simplest cases of illness.

The development of civic spirit is one of the definite aims of this book. The dependence of community health upon personal health is constantly emphasized and the importance of quarantine and of precautions against contagion is constantly brought out.

The author is indebted to his sister, Miss Selma Anderson, for aid in planning illustrations, to Miss Mary Dixon, whose skillful pen and brush prepared the drawings, and to many friends who supplied photographs.

R. E. B.

THANKSGIVING, 1922.

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HEALTH

PUBLIC AND PERSONAL

CHAPTER I

LIFE

Reflect that life, like every other blessing,
Derives its value from its use alone.

— SAMUEL JOHNSON.

The Boon of Health. — We want to work — to earn our living; we want to play — to enjoy our leisure; we want

FIGURE 2. — THATCHER'S GLEN.

Here, under giant elms and cottonwoods, flanked by hawthorns and with the river in the rear, Chicago parties make holiday, enjoying their leisure.

peace and content in our resting hours. These we can have only as we have health. The material luxuries that money can buy are insignificant as compared with the boon of health. It is told that John D. Rockefeller once said he would give a million dollars if he could eat cheese.

Keystone View Co. of N. Y.

FIGURE 3. — A GIRL ATHLETE.

This high school girl of Panama is an ideal of physical excellence which any girl might well emulate.

The activities of a healthy body in work and in play are a source of satisfaction and joy, dependent on no one's gift. Elemental satisfaction lies not in what we get but in what we do. We can experience this satisfaction only by keeping ourselves able to do, by living in perfect health.

Health means a condition in which every part of the body is acting normally, doing its work perfectly. The working of the body, activity, is life. Therefore our first step in the study of keeping in health is to learn how life manifests itself in the body.

How may the most elemental satisfaction in life be secured? What is health? What is the first step in our study of maintaining health?

The Living Substance.— There is a substance called *protoplasm* which exists throughout the bodies of plants and animals, and which is the only living material we know. In common plants some of the protoplasm has a coloring sub-

stance in it which makes the leaves look green. In the blood most of the protoplasm contains a coloring substance which makes that fluid look red. Otherwise most protoplasm is nearly colorless; it has the appearance of raw white of egg.

What is protoplasm? How may its appearance vary in living things?

Molecules and Atoms. — In order to understand the make-up of protoplasm we must know something of what chemists have learned about matter. Imagine a drop of water divided into particles as small as dust, then each of these particles again divided into many smaller particles, and these smaller particles divided again and again. This imaginary process would in time bring us to the smallest possible particle of water. This is called a *molecule* of water. The smallest particle of salt is a molecule of salt. The smallest particle of sugar is a molecule of sugar.

Every substance is composed of molecules, but they are too small to be seen by the most powerful microscope. However, by means of an electric current we can divide the molecule of water into still smaller particles called *atoms*. But when we divide the molecule of water into atoms, we no longer have water. We have two gases, *hydrogen* and *oxygen*. Every molecule of water is made up of two atoms of hydrogen and one atom of oxygen. In chemistry H stands for hydrogen and O for oxygen, so chemists indicate this make-up of the water molecule by the formula H_2O.

Explain what a molecule is. Explain what an atom is.

Elements and Compounds. — Since water is composed of two substances we call it a *compound*. But no one has ever been able to separate hydrogen and oxygen into any other substances, so we call them simple substances or *elements*. There are only about ninety elements known. All other substances in the world are compounds or mixtures of compounds. In nature compounds are constantly being broken down into their elements, and the elements reunited into

other compounds. This is called *chemical change*. It accompanies every activity of life.

Why is water called a compound? Why is oxygen called an element? About how many elements are known to chemists? Why is bread a mixture rather than a compound? What have compounds to do with life?

Composition of Protoplasm. — Since the activities of life consist (from the chemist's standpoint) in building up compounds and breaking them down, and since these changes take place within the molecule of protoplasm, we must know something of the composition of that molecule if we are to understand the activities of the body. The molecule of protoplasm is one of the largest and most complex molecules known. Though it contains many hundred atoms it is chiefly composed of four elements, — carbon, hydrogen, oxygen, and nitrogen. These elements you have perhaps already learned, — carbon as charcoal, pencil leads, or diamond, the other three as gases, hydrogen the lightest of all substances, not occurring free in nature, oxygen forming one fifth and nitrogen four fifths of the atmosphere.

These four elements are all contained in the food we eat. In the process of building up the protoplasm molecule, atoms of each element in the required number are taken from the food and joined together to form the living compound. In the breaking down process these atoms are released from their union in the large protoplasm molecule and make new combinations in smaller molecules. This is explained more fully on pages 10, 12, and 20.

Name the four chief elements of protoplasm. In what forms have you seen carbon? What sort of substance is hydrogen? What is oxygen and where does it exist free? Nitrogen?

Cells. — The protoplasm of a plant or animal is found in very small particles called *cells*. Each cell has a very thin covering or *cell wall*. Commonly some of the protoplasm which composes the cell is denser than the remainder and

is gathered together into a little body called the *nu'cle-us.* The nucleus can move about within the cell; it changes its form very much with some of the cell's activities. These cells together with the fluids, fibers, and minerals which lie between them make up the body. They have been likened to the bricks which compose a wall. The comparison is

FIGURE 4. — McKINLEY PARK, SACRAMENTO, CALIFORNIA.

This park, with its ball ground, tennis courts, boats, play apparatus, and club house, well exemplifies the modern thought that wholesome recreation is a necessity in healthful living.

good, though the cells do not have such a regular arrangement, and the "mortar" between them is sometimes more than the "brick."

On the other hand, the differences between the cells of the body and the bricks of a wall are very great. Since protoplasm has the power of movement, the cell is an active bit of matter. Muscle cells, for example, have the peculiar power of contracting to produce movements of the body. The cells of the sweat glands produce perspiration. In

short, the cells are more than building material; they do all the work of the body.

Cells have the power of communicating with neighbor cells. They also respond to outside influences. Changes of light and of heat, an electric current, a touch, produce responses in the protoplasm of cells.

Of what is a cell composed? What is the nucleus of a cell? In what respects are the cells of the body and the bricks of a wall similar, and in what important respects do they differ?

Sizes of Cells. — In size cells differ greatly. A large cell is one fiftieth or one hundredth of an inch in diameter. A common sized human cell is one two-thousandth of an inch across. Some small cells have a diameter of one ten-thousandth of an inch. The body contains cells of many different sizes. Those of adults are no larger than those of infants, but there are more of them.

How many large cells side by side would extend an inch? How many medium sized cells would there be to an inch? How many small cells? Do you grow simply by increase in the size of cells?

Form and Arrangement of Cells. — In form and arrangement cells are adapted to the work they have to do. If a cell's work is to exert a pull by shortening itself (muscle) it will be long and narrow. If a cell is to receive and send out communications (nerve cell) it will have branches for many contact points. If a group of cells is to act as a pavement on an exposed surface, as the skin and the lining of the mouth, each cell will be thin and flat and will overlap its fellows, like shingles. If cells are to secrete a watery fluid they will be plump and arranged in a single layer around the tube which carries off the fluid. If a cell is to be used for storage it will be about as nearly spherical as it can be with the other cells pressing against it.

Why have cells various shapes? Give the reason for the shape of each cell in the accompanying figure.

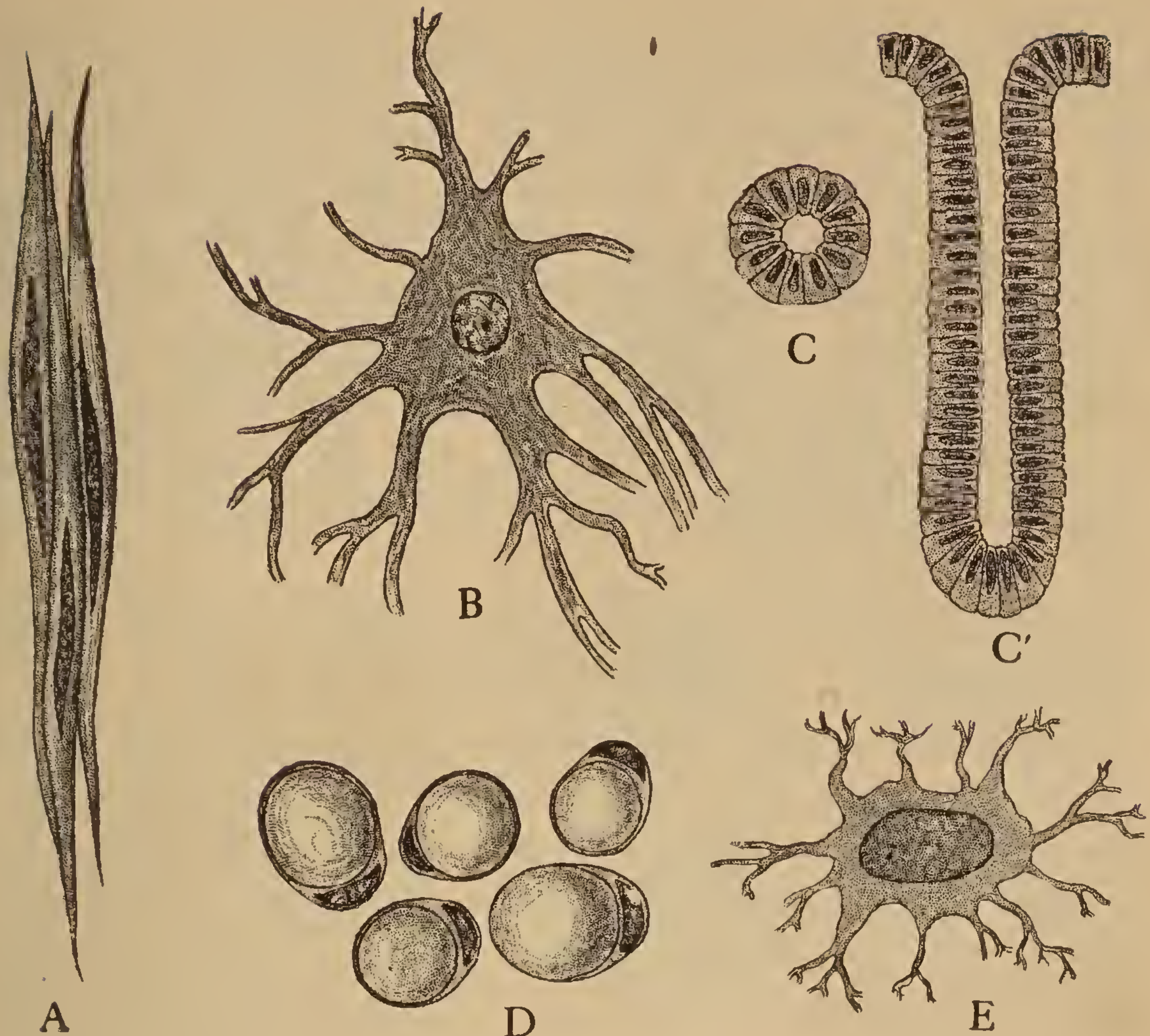


FIGURE 5. — EXAMPLES OF CELLS.

A. Three muscle cells, each with a nucleus, magnified 300 times. *B*. A brain cell, magnified 400 times. *C*. A cross section of a stomach gland magnified 200 times, and a lengthwise section of the same gland. *D*. Fat cells, each containing a droplet of oil, magnified 400 times. *E*. A bone cell, magnified 1000 times.

1. About what portion of an inch in diameter is the drawing of a fat cell?

2. Since the drawing is 400 times the size of the real cell how large would the cell be?

3. Compute the size of each kind of cell here shown.

4. How are the cells of the stomach gland arranged with reference to the tube which carries away the fluid they secrete?

5. Does the form of a brain cell adapt it to receive nerve currents from one source, or from many sources?

6. Which kind of cell is best adapted to contracting (shortening)?

Tissue. — Cells in some cases fit tight against one another, and in other cases are separated by a substance lying between them. Bones, for example, have a stony matter in the considerable spaces between the cells, and *tendons*, the straps that fasten muscles to bones, are largely composed of stout threads which lie between the cells. Substances that lie between the cells are called *intercellular material.* A group of cells of any kind, together with their intercellular material, is called *tissue.* We speak of brain tissue, liver tissue, kidney tissue, bone tissue, cartilage tissue, fat tissue, etc.

Give a definition of tissue. Name examples of tissue. What is the meaning of the prefix *inter* in the word *intercellular?*

Connective Tissue. — In bones, in tendons, and in the tough tissue that holds the bones together, the quantity of intercellular matter is large. This makes the tissue very strong. Such tissue is called *connective tissue.* It supports and binds together parts of the body. The strong intercellular material is the chief part of this tissue, and its cells serve to produce and repair it. On the other hand, in the brain, the muscles, and the glands, the cells are the important part of the tissue. Only a little intercellular fibrous structure is needed to support the cells, since it is the function, or duty, of these tissues to work, not to serve as supporting or binding material for other tissues.

What is the characteristic structure of connective tissue? What is its work? Why are there intercellular fibers in other tissues? What makes bones and tendons so strong? Why do the brain cells, and glands need but little connecting fiber in their make-up?

Lymph. — In little spaces which are distributed through all tissue there is a watery fluid called *lymph.* The lymph is the liquid part of the blood which has oozed through the walls of the smallest blood tubes, which are called *cap′illaries.* As soon as this liquid has passed from the cap-

illaries into the intercellular spaces it is called lymph. As it flows slowly about among the cells, it brings them food and oxygen, and gathers up their wastes. Then with its load of wastes it goes back into the blood.

What is lymph? Describe its movements.

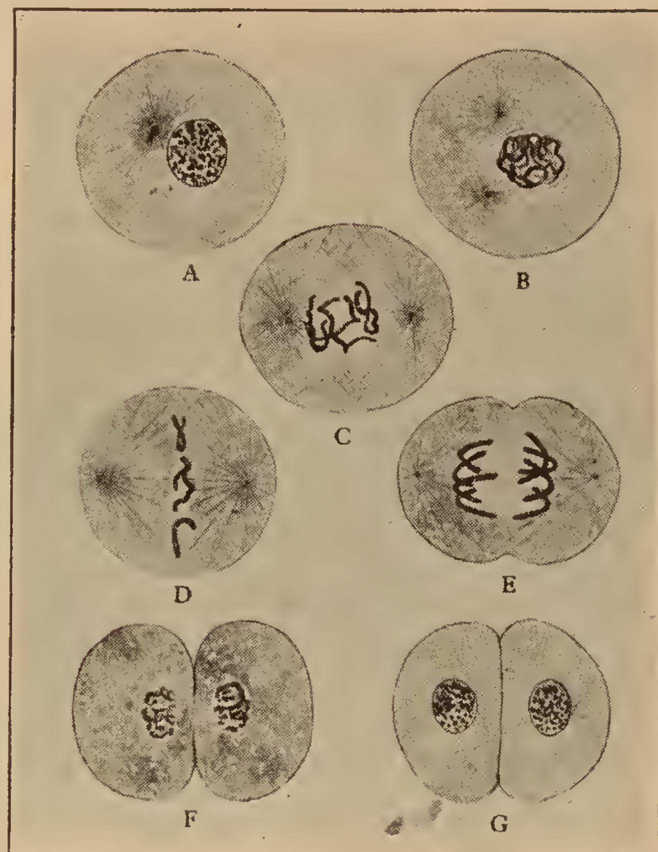


FIGURE 6. — CELL DIVISION.

These seven views represent a cell during the process of division. The star-like body seems to be a center around which the activities proceed. The granules of the nucleus in *A* have in *B* arranged themselves in lines, — a certain definite number for each plant or animal. In cell division each line of the nucleus divides, thus preserving the characteristic number.

Summary. — You will find the following ways of thinking of the body convenient and helpful: The body is a sack of moving liquids (blood, lymph) encased in a skin almost water-tight. It is shaped over a framework of connective tissues (bones and their binding straps). On this support the softer and more active tissues are fastened. It is everywhere alive because in all its parts is protoplasm in cells which are arranged either side by side in compact masses or with intercellular substances between them. The body is an aggregation of mutually dependent living beings (cells) immersed in a salt sea (lymph, blood).

What Life Is. — We all have a hazy notion of what life is, but we can get a more definite idea of it by learning the activities common to all life. In the first place *motion* — movement arising from a power within — is a character-

istic of life. We distinguish a living animal from a dead one by its power to move. In plants and in animals which grow fixed, with no power of locomotion, there is nevertheless movement within the cells. Movement is characteristic of all life.

Another distinguishing feature of life is *growth.* Growth consists of several processes. Every cell at some time assimilates food, that is, it takes various food substances, breaks up the molecules of which they are composed, and combines the atoms so obtained into molecules of protoplasm, thus increasing the quantity of live protoplasm in the cell. Another process in growth is cell division. Cells do not increase in size indefinitely. When a cell reaches a certain limit it divides into two cells, each complete but of small size. Each small cell assimilates food until it reaches its limit, then divides. A third process in the growth of tissue consists in the production of intercellular material. The cells take from the food the substances required and build them into intercellular fibers or mineral.

Another characteristic of life is the cell activity called *oxidation.* In the inanimate world the burning of fuel is an example of oxidation. The oxygen of the air combines with certain elements of the fuel, producing heat. Heat is a form of *energy* — which is another way of saying that heat has the ability to do work.

In the animate world the process of oxidation in the cell is practically like the burning of fuel in a furnace. Oxygen is brought into the cell and combines with some of the molecules, burning them up and so transforming their energy into heat and activity. Without oxidation in the cell we could have no muscle work, no brain work. Oxidation in the cell is as necessary to any bodily activity as oxidation in the fire-box of an engine is necessary to mechanical motion.

Life, then, consists of certain activities. Those discussed

above — motion, growth, and oxidation — are common to all cells. The peculiar duties of various kinds of cells you will learn as you study the functions of the different parts of the body.

Name the activities common to all cells. What is meant by assimilation? What is energy? What is oxidation? Name three processes involved in growth.

FIGURE 7. — A MUNICIPAL PLAYGROUND.

These children are experiencing a healthful breaking down of muscle cells. Every city should provide its children a safe place to play in the fresh air. It is a matter of health, safety, and education.

The Cycle of Life. — The chief activities of all cells may be restated as an alternation of processes, building up followed by breaking down. A muscle cell builds up by assimilating food. Then it breaks down by oxidation of many of its molecules in order to supply the energy for muscular contraction. A brain cell while you are sleeping assimilates food till it becomes plump and full; then while you are thinking or working it oxidizes, molecule after molecule,

until it becomes ragged and nearly worn out. Cells build up that they may break down. The breaking down is the end for which the cell exists. Thus life is a cycle of chemical changes.

What is meant by the cell's cycle of life? Why is it desirable that a cell break down?

Cell Needs. — Out of the activities of the cells arise certain needs. If the cell is to grow or to replace its broken-down parts it must have *food.* In order to break down by the process of oxidation the cell must be supplied with *oxygen.* In this process of oxidation certain wastes are produced just as ashes and gases are produced in a furnace. The chief of these wastes are *carbon dīox′id* (a gas resulting from the oxidation of carbon), water (produced by the oxidation of hydrogen), and certain substances containing nitrogen. Just as ashes must be removed to prevent their choking the fire and putting it out, so these *wastes must be removed* from the cell. This is done by the blood and lymph which move past the cell.

Another need of the cell is suitable temperature. Protoplasm can live only within certain *temperature limits.* These limits differ much for different cells. Our skin cells can endure a temperature of freezing for a short time and also a temperature of hot water, perhaps 120 degrees. The cells of the brain, liver, and other internal organs, when the body is in a healthy state, do not vary more than a degree or two from the normal, 98.6 degrees in the mouth. In sickness their temperature may go up or down ten or twelve degrees, but such changes are very serious.

List under four heads the needs of the cell. Why is food needed? Why is oxygen needed? Why must waste be removed from the cell? Discuss the range of temperature tolerable to protoplasm.

Supplying the Needs. — Every cell in the body has the needs named above. The body as a whole provides for the

needs of its own cells. It supplies the food and the oxygen, removes the wastes, and adjusts the temperature for the various cells. How it supplies its own needs is the problem, or rather series of problems, that will occupy our attention in this course.

The body differs from man-made machines in that it is self-managing and self-repairing. The parts all work in harmony to provide just the conditions necessary for the work of the whole human machine. If we are to be our own engineers we shall have to study the machine carefully, that our treatment of it may keep it working smoothly and not upset its delicate adjustments.

How does the body differ from man-made machines? Why do we need to study the human mechanism carefully?

CHAPTER II

THE BODY AT WORK

A sound mind in a sound body is a short but full description of a happy state in this world.

— John Locke.

The Activity of the Body. — In preparing to study this machine, our body, we ought first to get a general idea of how it works. To give such an idea is the aim of this chapter. Any plant or animal is called an *organism.* Its parts all coöperate to supply its own needs. The human organism is the body working as a unit, all parts coöperating to provide for the needs of every part.

As we go on in the succeeding chapters to take up in detail various studies in individual and community health, we shall understand them the better for being able to relate them to the organic activities of the body. We can not get the best out of the practical studies that follow unless we first learn thoroughly the organic activities in this chapter.

To make the chapter simpler and clearer it is divided into nine sections, which illustrate the various functions of the body. These are: (1) movements, (2) food, (3) oxygen, (4) transportation, (5) elimination of wastes, (6) regulation of temperature, (7) control of the body, (8) sensation, and (9) protection.

Section 1. Movements

Transformation of Energy. — The muscles and bones compose most of the body. They have for their function the movements of the entire body or of its parts. This

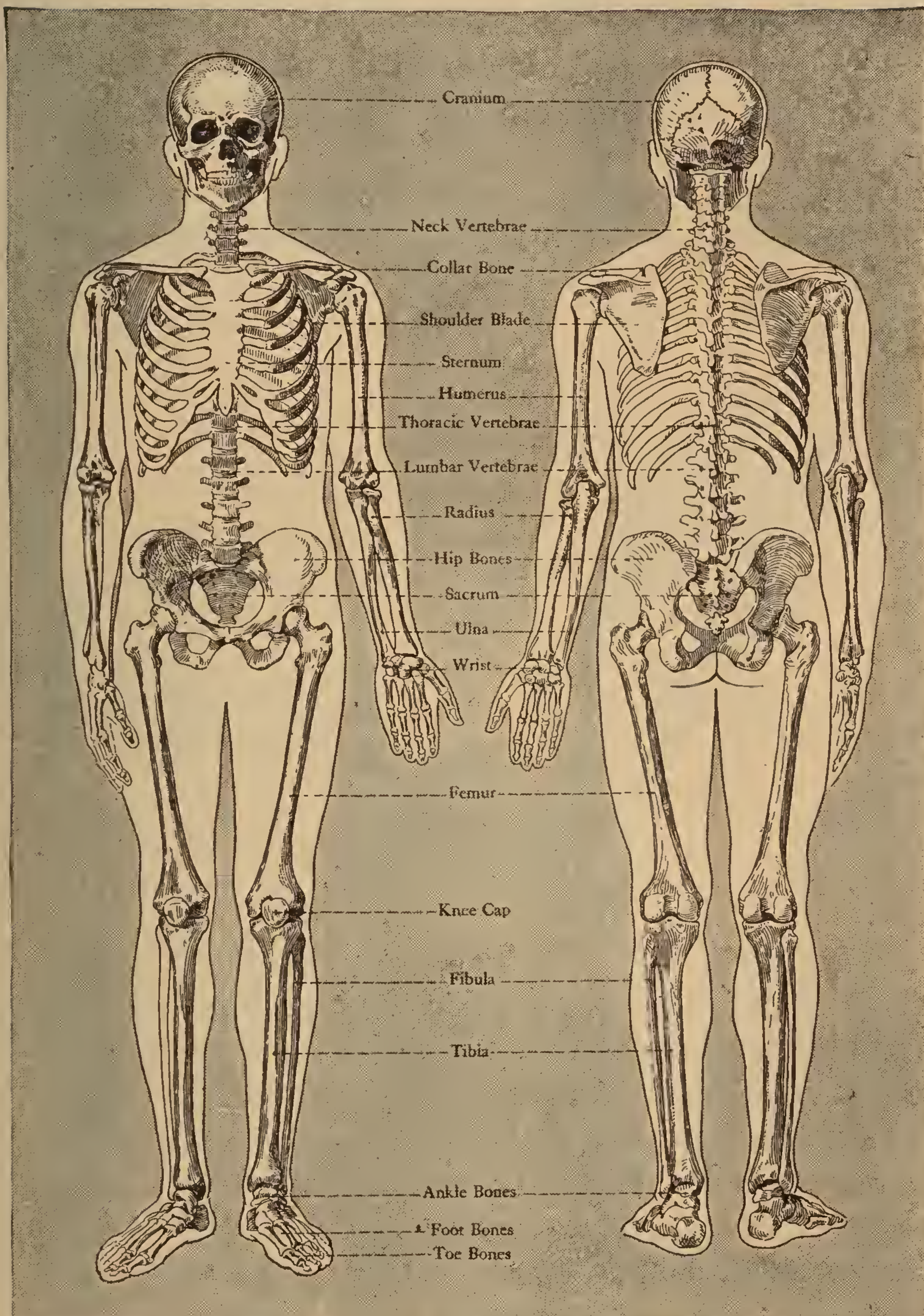


FIGURE 8. — THE FRAMEWORK OF MAN.

means the transforming of energy, which is supplied in the form of food and oxygen. The food must be obtained, taken in, prepared for the cells (digested), and transported by the blood along with oxygen to the muscle cells. There it is oxidized to liberate energy, and this energy the cells transform into motion.

Muscles and Tendons. — The muscle is composed of long cells or fibers. To produce motion the fibers contract.

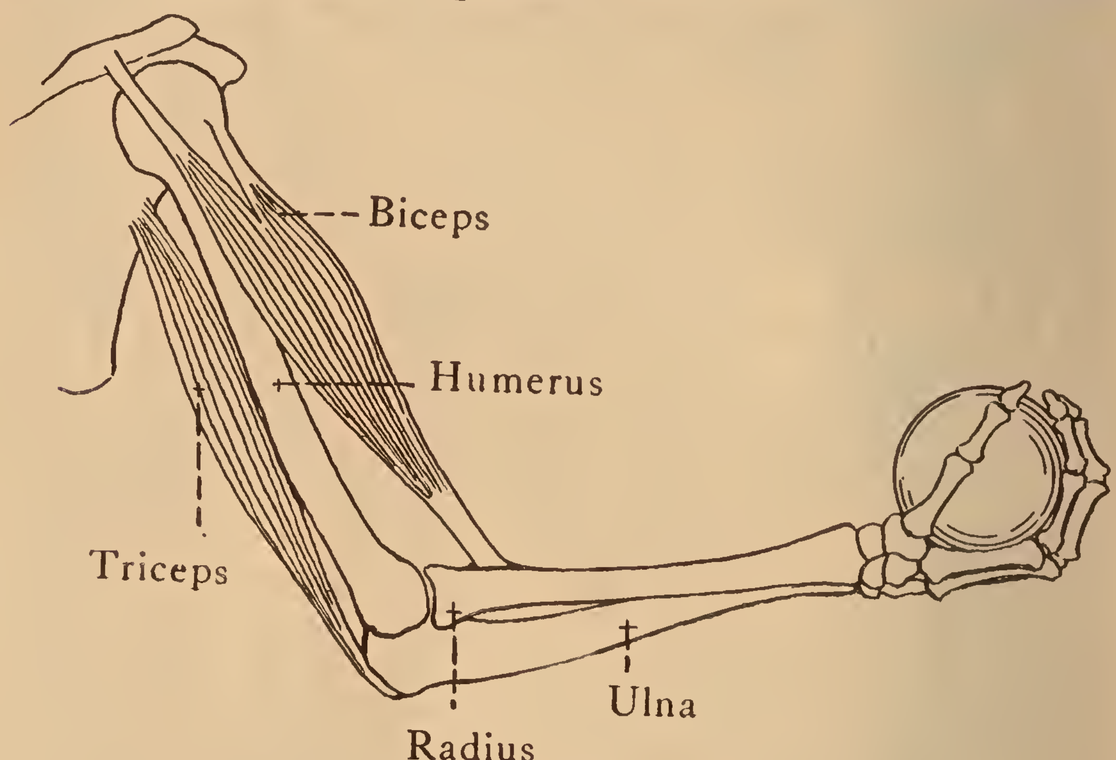


FIGURE 9. — ARM MUSCLES.

These muscles are used in bending and in straightening the elbow.

This draws on the bone to which the muscle is fastened and so produces movement in the skeleton. For example, when the arm is held out straight the forearm may be drawn upward and backward toward the head by the contraction of the muscle called *bī′ceps* acting on the bones of the arm as levers. It is thrust out again by the contraction of another muscle called *trī′ceps*. Muscles exert force only in contraction.

The muscles are fastened to the bones sometimes directly and sometimes by means of *tendons*. The tendons, as has been said, are composed chiefly of long parallel threads of

intercellular fibers, the toughest structure in the body. By means of long tendons, muscles can be situated at some convenient place and yet produce movement in a part of the body at a distance. For example, the muscles that bend the fingers are in the arm near the elbow, and the muscles that lift the toes are in the shin.

FIGURE 10. — TENDON FUNCTION.

A muscle situated near the elbow is connected by a long tendon with the finger which it moves.

Bones and Ligaments. — To serve as strong levers for the movements of the body the bones are made stiff by stony material like marble or limestone, which is deposited between the cells all through the bone. Stony matter alone would be brittle. To make the bone tough there is mingled everywhere with the stone between the cells an animal or gristly material. Where two bones meet at a movable joint they are fastened together by strips of tissue like tendon called *ligaments*. The joint cavity is lined with a smooth membrane, the *synovial sac*, always kept slippery by a watery fluid, so that there is practically no friction in the movement.

Involuntary Movement. — Most of the muscles of the body are fairly large and attached to the skeleton; that is, the bony framework of the body. These produce our common visible movements, but there are other muscles to produce other movements. In the stomach wall, for example, is a sheet of muscle, thick and strong, to knead the food during the process of gastric (stomach) digestion. Throughout the wall of the digestive tube are thin sheets of muscle whose contractions cause the food to move along. In the walls

of arteries and veins are thin sheets of muscle whose cells, running around the tubes, contract to make them smaller when less blood is to be carried through them. The heart is a mass of muscle which contracts oftener than once a second to force the blood through the body.

How do muscle cells transform food energy into motion? Give as many reasons as you can think of why movement is necessary. How do muscles and bones coöperate to produce motion? What is a tendon or sinew? Why is it so tough? Where are a few of the longest tendons of the body?

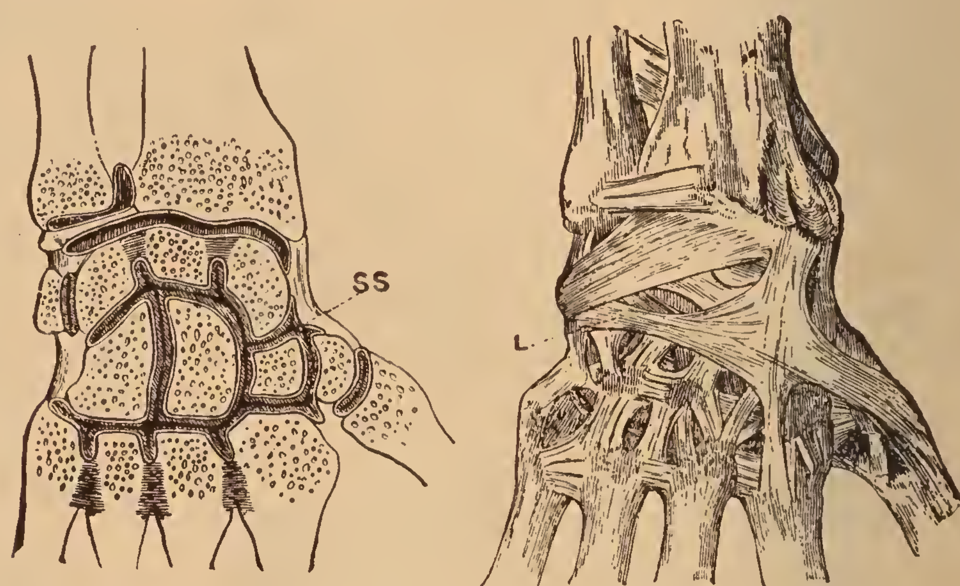


FIGURE 11. — THE WRIST.

The first sketch shows the bones with the synovial sacs (darkly shaded) between them. The second sketch shows the ligaments which bind the bones together.

Of what two kinds of material is bone mainly composed? What is the chief advantage of this combination of material?

What are ligaments? How is friction at a joint prevented?

Why is there need of muscle in the wall of the intestines? Why should the sheet of muscle in the stomach wall be heavier than the intestinal muscle? How is the blood made to flow through the arteries?

Section 2. Food

Food for Building and Repair (Protein). — Every cell of the body needs food. The kind and quantity of food de-

pends on the use the cell makes of it. All cells while growing need food which contains all the elements of which protoplasm is composed (chiefly carbon, hydrogen, oxygen, and nitrogen). This is supplied by foods containing *prō'te-in.* Our chief protein foods are meat, fish, eggs, milk, and

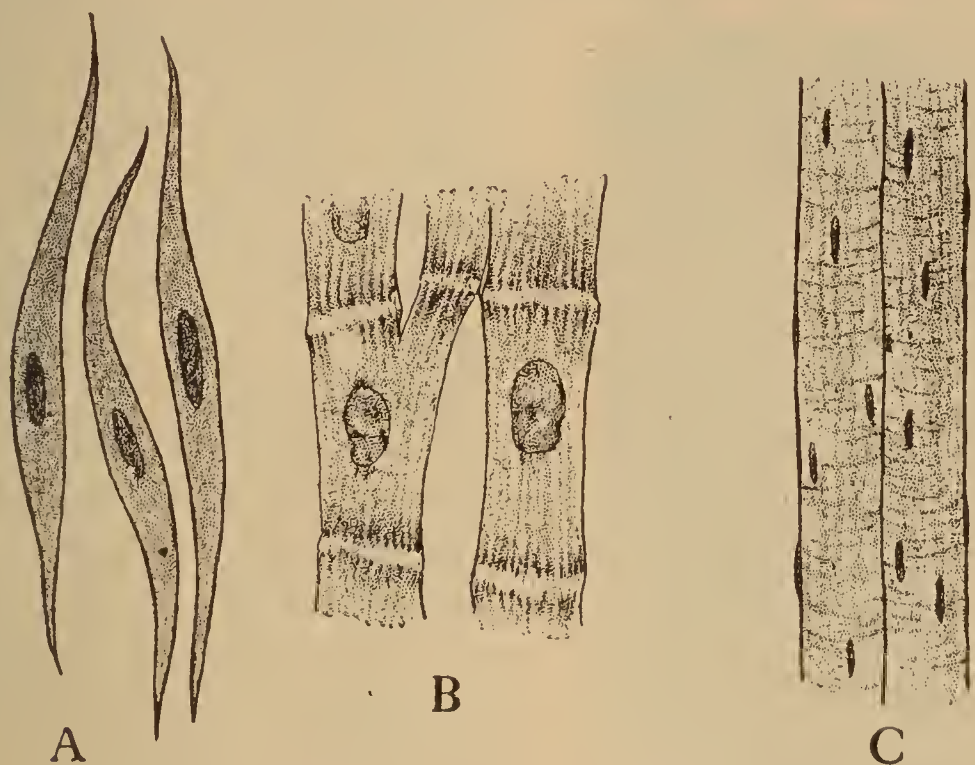


FIGURE 12. — MUSCLE CELLS.

A. Three smooth muscle cells from the wall of the stomach. *B*. Muscle cells from the heart. *C*. Portions of two fibers or cells of a skeletal muscle. The fibers are so long that they can not be shown entire. The smooth cells are most magnified and those of the skeletal muscle least.

1. Cells of which variety of muscle have many nuclei?
2. Which cells have a branch at one side?
3. Point out any other differences you can see between these three kinds of muscles.

the legumes. But water and certain mineral compounds are also necessary for making protoplasm. The minerals we get to a small extent from drinking water, but chiefly from meat and vegetables. Cells which are very active have many of their molecules broken down in their activity and require for building up new molecules the same kinds of food (protein) as for growth.

Food for Energy. — The more active cells, as muscle and nerve cells, oxidize a great deal to liberate the energy for their activity. To supply material for oxidizing, the food does not need to contain all the elements of protoplasm as does food for building and repair. But it must contain carbon which combines with oxygen to give energy when the cell breaks down. Though protein may be oxidized to supply energy, the foods which are best for this purpose are the *fats* and the *carbohy'drates* (starches and sugars). The carbohydrates we get chiefly in bread, cereals, vegetables and fruits. These foods are composed of carbon (C), hydrogen (H), and oxygen (O) only. When carbon oxidizes, it unites with the oxygen and forms a compound called carbon dioxid, which chemists indicate by the formula (CO_2). The hydrogen and oxygen combining form water, H_2O. (See page 3.)

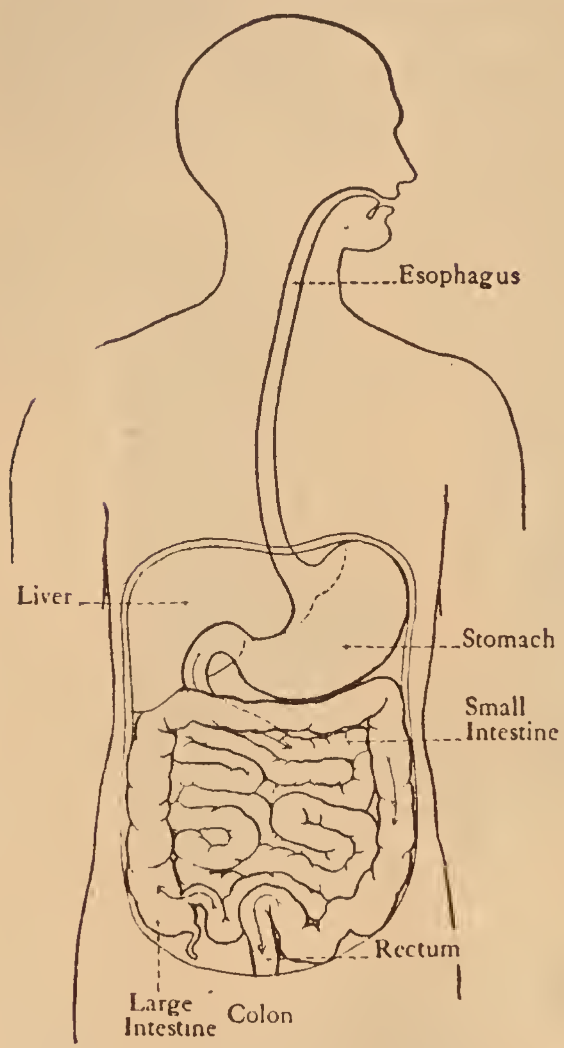


FIGURE 13. — DIAGRAM OF THE DIGESTIVE TRACT (front view).

1. Name in order the parts of the digestive tract.

2. What large digestive gland lies in the upper part, right side, of the abdomen, overlapping the stomach to the dotted line?

3. In what part of the abdomen does the small intestine join the large intestine (the colon)?

Protein foods contain nitrogen as well as carbon, hydrogen, and oxygen. Therefore when a protein oxidizes there are certain nitrogenous wastes formed in addition to carbon dioxid and water. Getting rid of these nitrogenous wastes puts an extra strain on the

kidneys. Since we need less food for growth than for energy, it is better to eat more abundantly of the carbohydrates and fats than of the proteins.

The Digestive Tract. — The digestive tract is a tube about twenty-five feet in length extending through the body. The stomach is an enlargement of this tube. Its function is to store the food, partly digest it, and pass it on to the small intestine a little at a time. The small intestine, as large in diameter as the thumb and some twenty feet in length, lies coiled in the middle of the *abdo'men.* The large intestine, nearly as large in diameter as the wrist and about five feet long, begins where the small intestine ends, in the right lower part of the abdomen, extends up along the right side, crosses over below the liver and stomach, turns down to the left lower part of the abdomen, bends across to the middle and then straight down to the end.

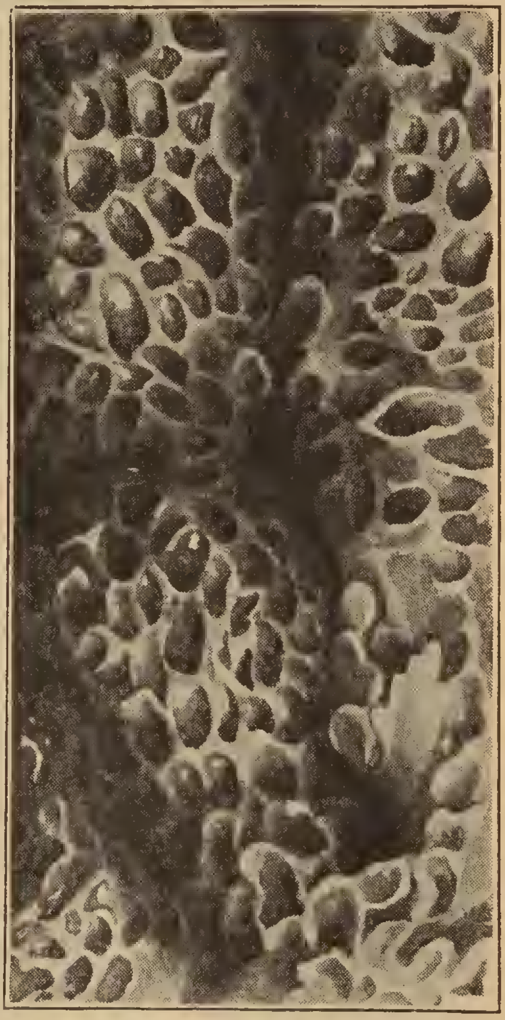


FIGURE 14. — GASTRIC GLANDS.

A surface view of the mucous membrane of the stomach, showing folds of the membrane and the mouths of many gastric glands, magnified.

Digestive Fluids. — Throughout the length of the digestive tube is a lining called *mucous membrane.* This membrane produces digestive fluids — abundantly in the stomach and small intestine, where most of the digestion takes place. The *sal'ivary* glands, opening into the mouth, and the *liver* and *pancreas* in the abdomen contribute digestive juices which enter the tract through passages called *ducts.*

Digestion. — The object of digestion is to reduce the food to a liquid, that it may go through the mucous membrane of the intestines and the walls of the capillaries; and to bring it to such a chemical condition that the cells can assimilate it. The mechanical part of this work is done mostly in the mouth, where the food is chewed into small fragments, and in the stomach, where by a kneading process it is mixed with digestive juices. The chemical part of the work is done by substances in the various juices which cause the food to take up water and break into other foods having smaller molecules. These substances are digestive agents called *en'zymes.* In this process of digestion the carbohydrates are all changed to *glucose* (a kind of sugar); the proteins to other nitrogenous substances. The fats and oils are broken up to get them through the lining of the intestine but they are changed back to oils before they get into the blood.

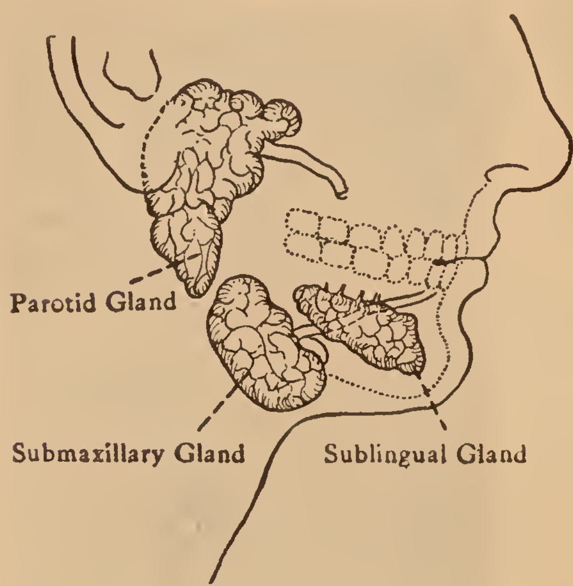


FIGURE 15. — THE SALIVARY GLANDS.

Give the locations of the openings of the salivary ducts.

Absorption and Refuse. — When the food has been digested it is absorbed into the blood, mostly in the small intestine, leaving in the large intestine the *fe'ces.* These are composed of the indigestible woody and tough parts of what we eat, together with excretions from the liver and intestinal glands.

How do proteins differ in composition from fats and carbohydrates? Why should we eat more carbohydrates and fats than proteins? From what foods do we get the minerals needed in the body?

What is accomplished in the digestive process? In what two organs is most of the mechanical work of digestion accomplished? What are the enzymes? What changes does the process of digestion bring about in carbohydrates? In proteins? In fats?

FIGURE 16. — X-RAY OF THE CHEST.

The trachea and bronchial tubes of a dead body are filled with a metal paste to make them opaque for the X-ray. They show dark in the illustration. The smallest tubes and air sacs did not in most places fill with the paste and consequently do not show. Where the air sacs did fill they make the large blotches.

1. Into how many large bronchial tubes does the trachea divide at its lower end?

2. Sketch a small portion of the right upper "bronchial tree" to show the plan of branching.

What are the parts of the digestive tract? Where are digestive fluids produced? In what part of the digestive tract does most of the absorption take place? Of what are the feces composed?

Section 3. Oxygen

Getting Oxygen. — The process of getting oxygen is a very easy matter. One fifth of the air all about us is oxygen. The oxygen would go through the skin and so supply our needs but for two things: first, the skin is too thick, almost gas-tight; second, its surface is not large enough. Therefore, we have a special breathing organ, the lungs, which are situated along with the heart in the chest or thorax.

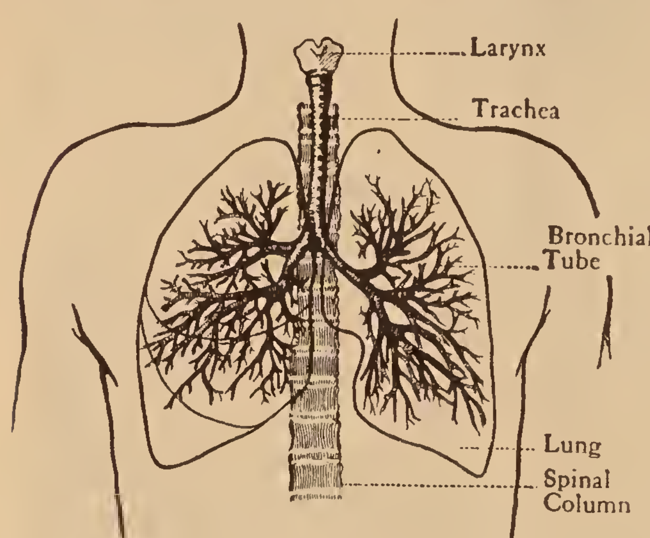


FIGURE 17. — RESPIRATORY ORGANS.

This diagram represents the main divisions of the "bronchial tree." The next figure shows the way in which each small bronchial tube ends in an irregular chamber where the gases are exchanged with the blood.

Breathing. — To get air into the lungs we breathe. The rhythmic movement of the body in breathing is much like the working of a bellows. The floor of the chest (*di'aphragm*) and a set of muscles in the side walls contract to make the chest larger. This makes the air pressure within less than that without, and the outside air pushes in. Then abdominal muscles and a different set of chest muscles contract to push up the diaphragm and move the walls in so as to make the chest smaller. This puts the air in the lungs under greater pressure than the air outside and drives some of it out.

The Lungs. — When we breathe, the air goes through the *tra'chea* (windpipe) and *bronchial tubes* to the *air sacs*, which are arranged at the ends of the bronchial tubes something as leaves on the twigs of a tree. These air sacs are

lined with a thin membrane, on the other side of which is a network of blood capillaries. There are so many million air sacs that, though each is as small as a needle's eye, the total surface of their lining membrane is hundreds of square feet. The air in the sacs contains comparatively more oxygen than does the blood. Therefore some of the oxygen diffuses (flows) through the membrane from the air into the blood, where it is loaded into the red corpuscles and so carried to all parts of the body.

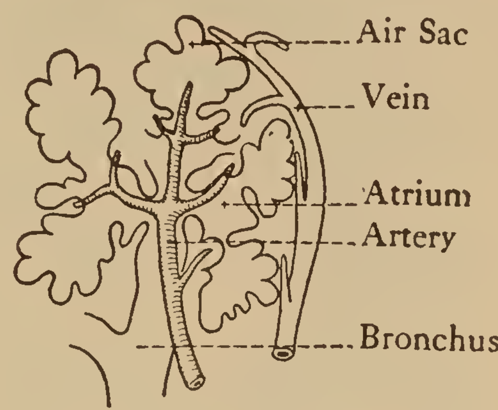


FIGURE 18.—AIR SACS OF THE LUNGS.

The atrium at the end of the bronchial tube is the "hall-way" from which the sacs open. The walls of the atrium and sacs are covered with a network of capillaries connecting the arteries with the veins.

Why does the oxygen not enter the body through the skin? What is the purpose of breathing? Describe the process of breathing. How is it possible for the lungs to have hundreds of feet of lining membrane exposed to the air? Where are the air sacs situated and how are they constructed? Where is your trachea? Where are your bronchial tubes? What makes the oxygen go from the air sac into the blood?

Section 4. Transportation

Blood and Lymph. — The work of carrying substances from one part of the body to another is done by the blood and the lymph. They are kept in motion, streams running to all parts of the body through containing tubes (arteries, capillaries and veins) chiefly by the action of the heart. Whatever is in these moving streams is carried along. The chief substances to be transported are food, oxygen, carbon dioxid, nitrogenous wastes, and white blood corpuscles.

The food and nitrogenous wastes are dissolved in the watery part of the blood, called *plasm*. But this warm fluid can dissolve very little gas; and therefore the two

gases, oxygen and carbon dioxid, must be carried in some other way.

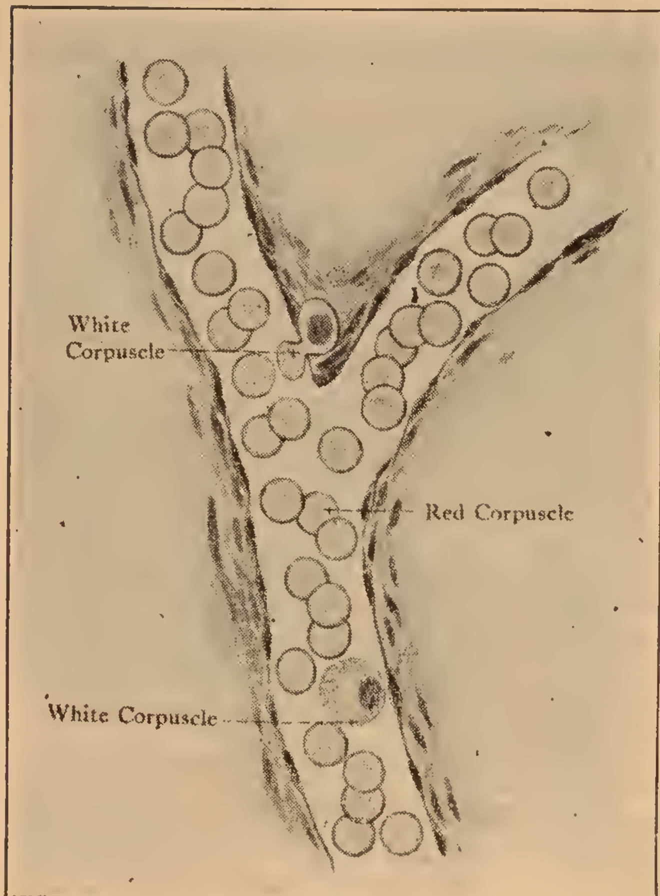


FIGURE 19. — BLOOD IN A CAPILLARY.

Between the corpuscles, floating them along, is the stream of watery plasm. One white corpuscle is shown moving through the wall of the capillary.

Corpuscles.—This other way is provided by the *red corpuscles* in the blood. These are modified cells especially adapted to carry oxygen. They exist in such great numbers that they form about half the weight of the blood and give the blood its characteristic color. There are about 5 millions of them in every drop of blood as large as the head of a pin.

These red corpuscles can hold many times as much oxygen as can dissolve in the plasm. When the red corpuscles give up their loads of oxygen to the tissues, they take on some of the carbon dioxid waste to be returned to the lungs. The carbon dioxid, little of which dissolves in the plasm, unites with other substances

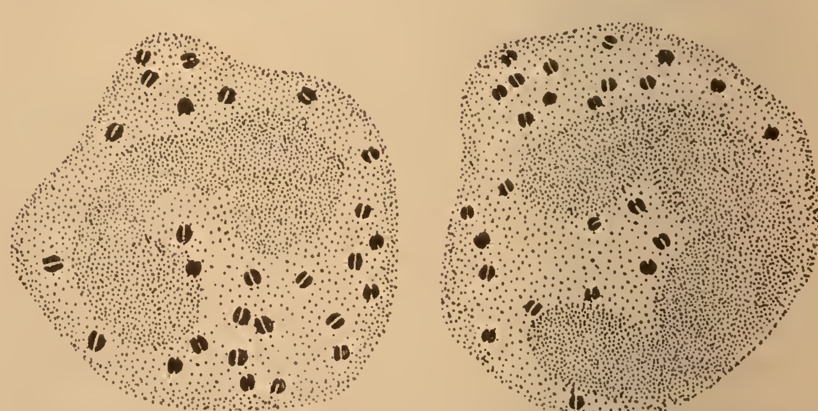


FIGURE 20. — PHAGOCYTOSIS.

These two white corpuscles (phagocytes) have engulfed many bacteria of brain fever. Note the peculiar large nuclei of the corpuscles.

in the blood to form compounds that will dissolve. Thus it is carried back to the lungs, where these compounds are broken down and the carbon dioxid is expelled by breathing.

The blood also contains many *white corpuscles*, cells whose work is to destroy bacteria, the tiny forms of life that cause disease. There is one white cell for about every 600 or 800 red corpuscles when the body is in normal health, but the number increases as the number of hostile bacteria increases in the body. The white cells float along in the blood stream like policemen patrolling a beat. When they are needed at any particular place they drop out of the stream and collect in large numbers to fight the bacteria. If the germs to be fought are outside the blood-tubes, the white cells worm their way through the capillary walls and skirmish about in the lymph spaces. When a white cell encounters a germ, it wraps itself about its enemy and thus devours it.

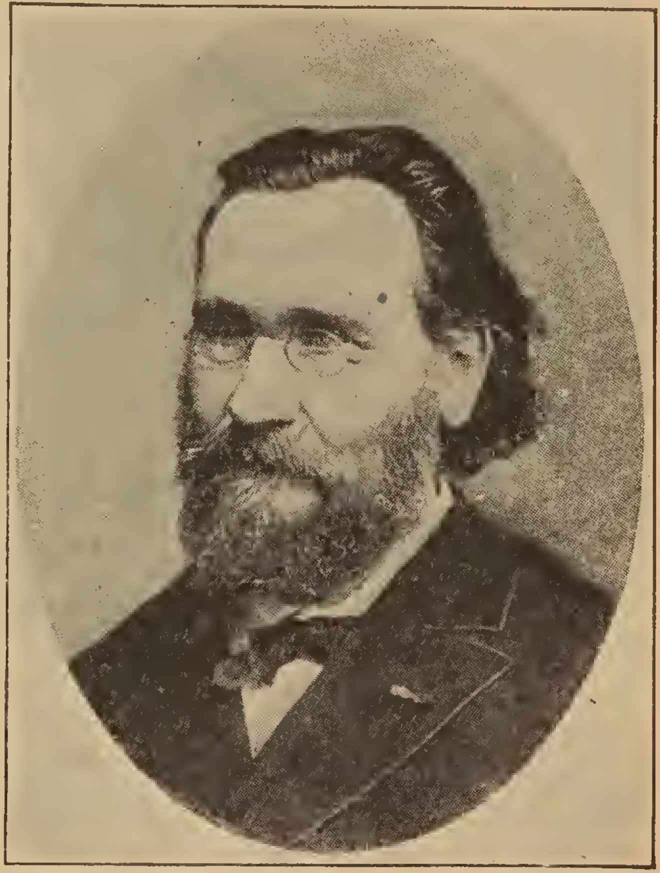


FIGURE 21. — ILIYA METCHNIKOFF, 1845–1916.

This Russian was a profound student of the lower forms of life. He proved that the white blood cells destroy bacteria in the body and so cure disease. He was made director of the Pasteur Institute on the death of Louis Pasteur.

The Blood Tubes. — The arteries are the tubes or vessels which carry the blood from the heart to all parts of the body. They are much like the branches of a tree, dividing into smaller branches as they get farther from the trunk. The

smallest blood tubes, capillaries, receive the blood from the smallest arteries and carry it to the smallest veins, which join to form larger veins that carry the blood back to the heart. So long as this system of blood tubes remains unbroken the blood flows in it, going round and round in its circuit from the heart through the arteries, the capillaries, the veins, and back to the heart; then through the lungs and back to the heart again.

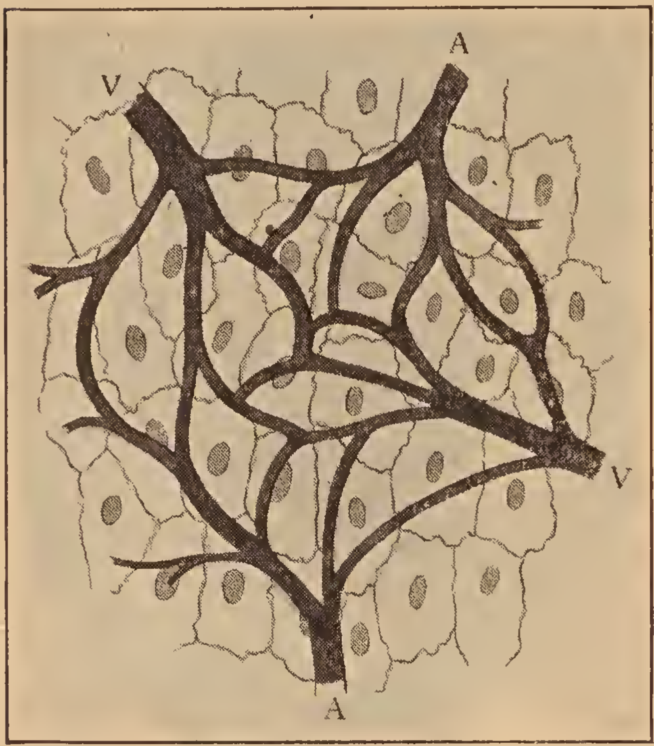


FIGURE 22. — DIAGRAM OF CAPILLARIES.

This figure illustrates a network of capillaries into which the blood is brought by small arteries and from which it is drained by veins.

The capillaries, making a fine network in every part of the body, are the delivery lines of the transportation system in which the blood receives and gives up its loads. They have unimaginably thin walls. As the blood goes along the capillary tubes from the arteries to the veins a portion of the plasm soaks or is forced through these thin walls and gets into all the minute spaces between the cells all over the body. This fluid, as has been said before, we call *lymph*. After it gives its food and oxygen to the cells and takes from the cells the carbon dioxid and nitrogenous wastes, which have been formed by oxidation, it returns to the blood. It returns in two ways: some of it with its wastes goes right back through the capillary walls into the blood stream; the rest is gathered up in a separate system of tubes, the *lymphatics*, and is carried up to a large vein in the left side of the neck where it also joins the blood stream.

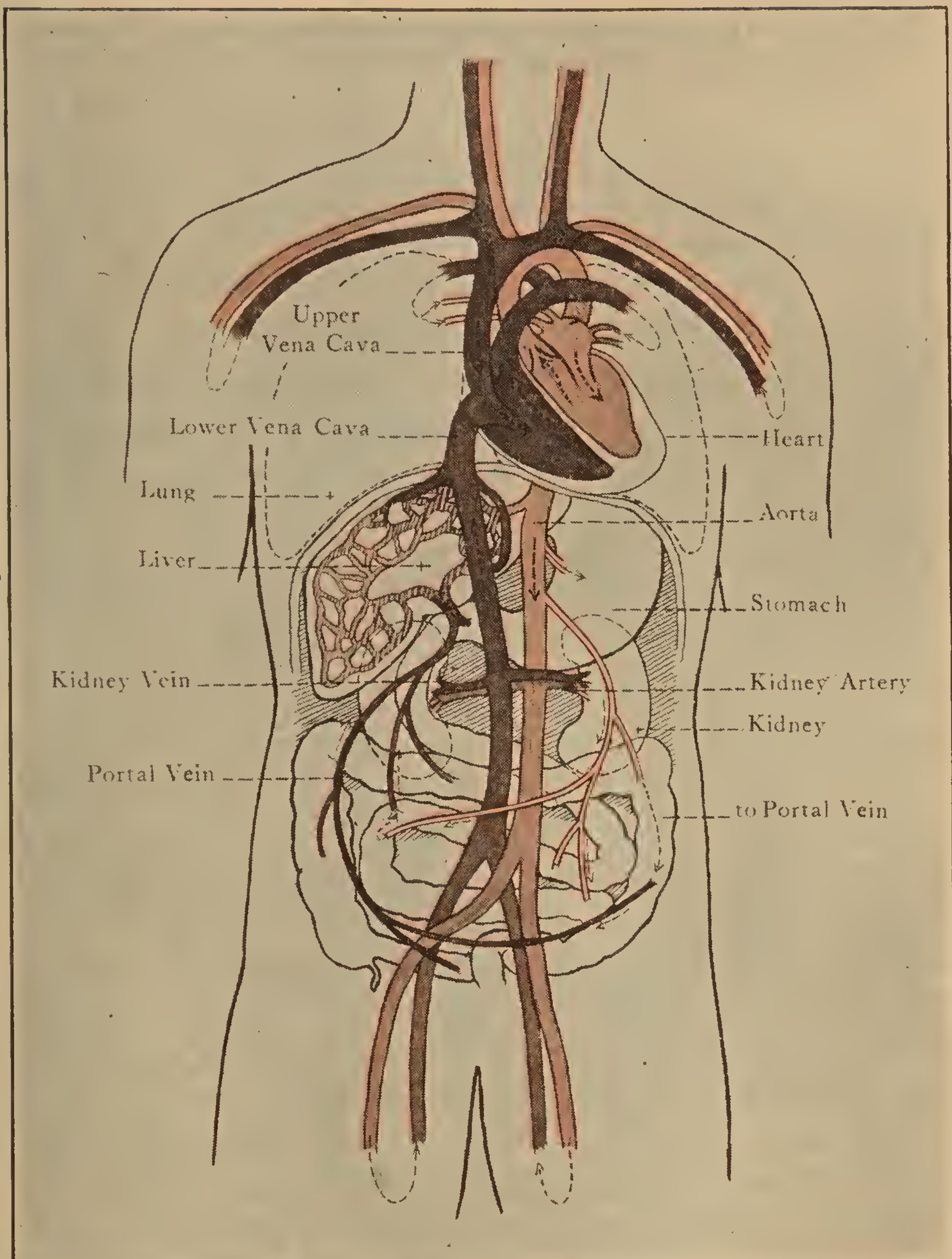


FIGURE 23. — DIAGRAM OF THE BLOOD CIRCULATION.

The dotted lines represent the small vessels which extend from large arteries to large veins. With a pointer trace the course of the blood from the left side of the heart (the reader's right) through the aorta and one of its branches to a leg, and then (following the arrows) back to the heart, from there to a lung, and back to the left side of the heart. In the same way trace the blood course to each of the following and back to the starting point: a kidney, an arm, the liver, the intestines.

What are the chief substances that the blood has to transport? How are food and nitrogenous wastes carried? What are the red corpuscles and what service do they perform? Tell how the white cells of the blood protect the body. Describe briefly the circulation of the blood from the heart back to the heart. Explain fully why the circulation of blood in the capillaries is important. How is lymph returned to the blood?

Section 5. Elimination of Wastes

We have seen that whenever protoplasm oxidizes, as muscle cells do when we move and brain cells do when we feel, think, or act, certain wastes are produced, — carbon dioxid and several substances containing nitrogen.

By the Lungs. — The first of these wastes, carbon dioxid, would diffuse out of the body wherever it could, since there is relatively so much of it in the body and so little outside. But the only place where it can get out in quantities that amount to anything is the lungs. While the oxygen is coming from the air sacs into the blood the carbon dioxid is moving through the same membrane from the blood into the air sacs. When we exhale, the carbon dioxid is thrown out into the air.

By the Kidneys. — The nitrogenous waste is removed from the blood chiefly by the kidneys, a pair of organs in the back part of the abdomen. It is carried in the blood as *urea,* dissolved in the plasm. As the blood circulates through the kidneys considerable water containing urea in solution filters through the kidney cells and is carried by a tube from each kidney to the bladder, where it is stored as urine until it is discharged. The kidney cells have the power of letting the waste, urea, together with salts which are in the blood, go through with the water, but they hold back in the blood almost all of the things the body needs, — sugar and protein foods.

By the Skin, Liver, and Intestine. — The skin, through the sweat glands, removes from the blood a little waste

similar to the urine, but when a person is in health the quantity is very small.

The liver, a large gland in the right part of the abdomen, takes certain nitrogenous wastes out of the blood and passes them in the bile to the intestine. Much of the bile is absorbed with the food in the intestine, but the wastes, which

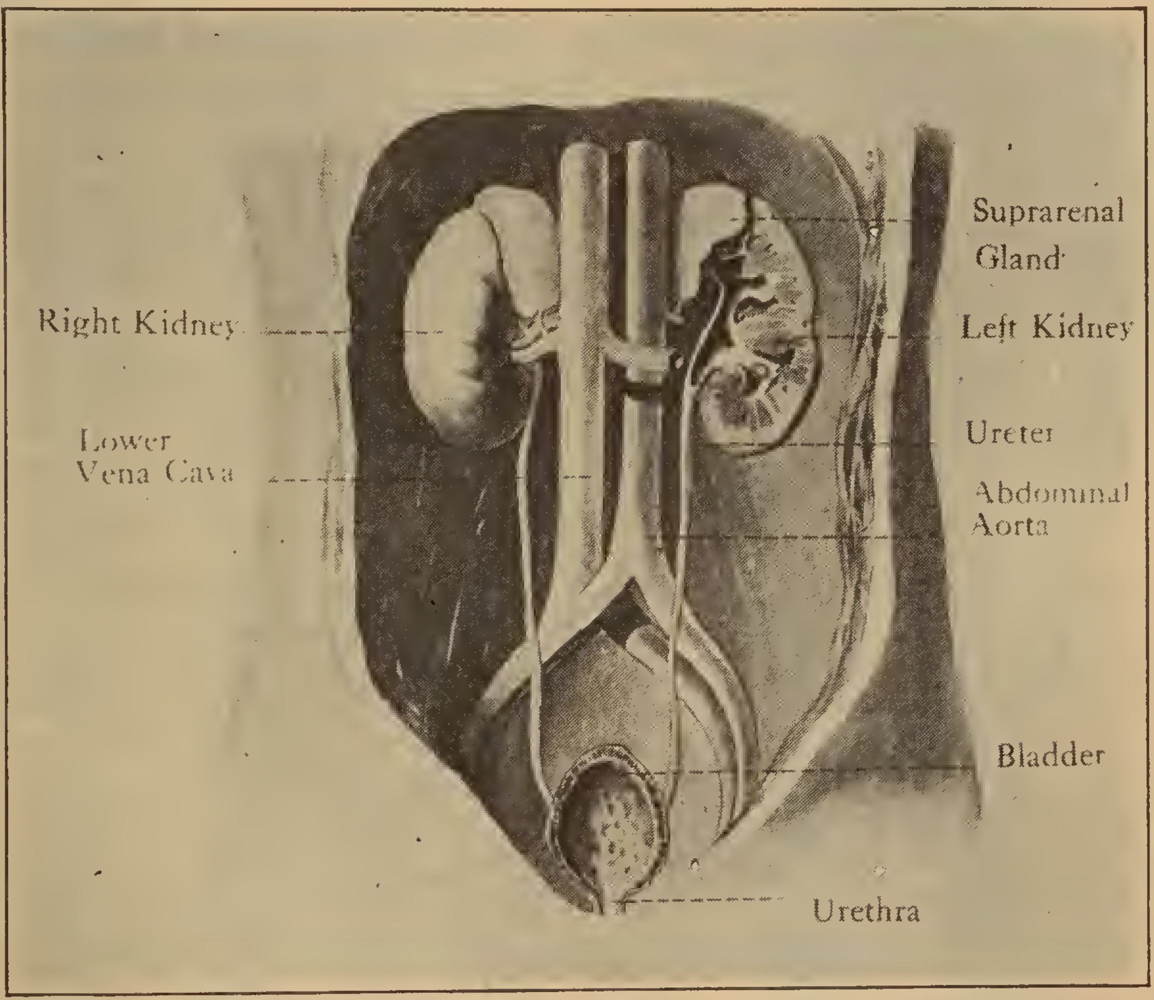


FIGURE 24. — KIDNEYS.

The left kidney is sliced open to show the collecting chamber (pelvis) from which the urine is drained through the ureter into the bladder.

are in the form of solid grains, pass along and are discharged in the feces. The intestinal mucous membrane also excretes certain nitrogenous wastes that are carried away with the feces.

How does there come to be waste in the cells? How is the carbon dioxid removed from the blood? What is the chief way in which nitrogenous waste is removed? Why is the kidney some-

times called a "selective filter"? What is the second important way in which nitrogenous waste is removed? Why are not the wastes of the bile largely absorbed as they go along through the intestines? In what other way is a very small quantity of waste taken from the blood?

Section 6. Regulation of Temperature

Control of Heat by the Skin. — All our activity produces heat. That our temperature may remain constant we have to get rid of the heat as fast as it is produced and no faster. When we are very active we produce much heat and when inactive we produce little. Therefore, we must occasionally get rid of several times as much heat in a minute as at other times. To some extent we control our rate of cooling by artificial means, — fire, bath, change of clothing. But the body itself must do the fine work of precise adjustment.

The body controls its loss of heat in two ways. The skin always radiates heat, more rapidly when it is warm, less rapidly when it is cool. The temperature of the skin depends internally on the quantity of blood sent through it. When we are producing much heat our body automatically sends much blood into the skin, making it hot so that it radiates much. When we produce little heat little blood is sent to the skin; it is cool and radiates little.

The other means of cooling the skin is by the evaporation of perspiration. When we are producing much heat by our activity, much perspiration is made to flow out on the skin. The more liquid evaporated, the greater the loss of heat from the skin. When we are comparatively inactive and producing little heat, little perspiration is formed, and little heat is lost by its evaporation. Much vapor in the air retards evaporation and interferes seriously with temperature regulation. That is why we feel warmer on a muggy day than on a dry one. A breeze, on the other hand, carries away the vapor and facilitates evaporation.

When we have a fever the flow of perspiration is checked and our temperature runs up. In illness sometimes the production of heat does not keep up with its loss and the temperature goes down. In exposure to intense cold the heat production can not always keep up with the loss and a serious decrease in temperature results. In health, however, under ordinary circumstances the body can so nicely adjust its loss of heat to its production as to maintain an almost perfectly uniform temperature.

By what two methods does the body control its loss of heat automatically? How can the skin be made to radiate more heat at one time than at another? Why does the skin not cool well on a sultry day? How can a gentle breeze which is warmer than the body cool it? Why does the temperature go up in fever?

FIGURE 25. — THE NERVE SYSTEM.

Section 7. Control of the Body

The Nerve System. — That all the activities of the body may harmonize, that one muscle may coöperate with an-

other instead of working at cross purposes, that the glands may secrete at the proper time and only then, they must all be under the direction of one central control. The *nerve system* forms such a directing center. Its structure is adapted to its work. The centers of control are called *gan'glia.* They are composed of large nerve cells having a few large branches which subdivide into a great many small ones. Through these minute branches, some of which are extended in fine threads two or three feet long, the various ganglia are connected with one another and with every part of the body. These ganglia stimulate and control the activities of every portion of the body. The chief ganglia are the brain and spinal cord.

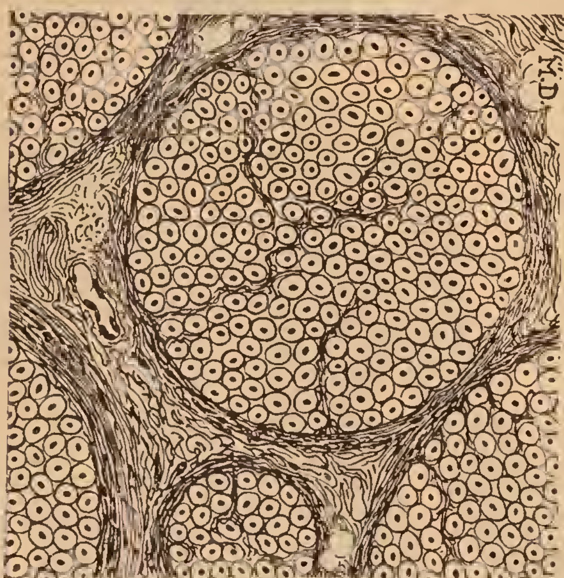


FIGURE 26. — CROSS SECTION OF A NERVE (much magnified).

The nerve is composed of several bundles of axons, each bundle wrapped by connective tissue fibers. What is the appearance of an axon?

A nerve is a white cord, composed, like a telephone cable, of many insulated threads which connect one ganglion cell with another or with a muscle cell, a gland, or sense organ.

Voluntary Control. — Nerve currents are continually surging through the nerve system giving rise to all our movements, thoughts, and feelings. Every impression we receive from without sends a stream of nerve currents to the spinal cord and brain. When the current reaches the large part of the brain (*cer'ebrum*) we feel the impression. All actions which are intended (that is, *voluntary actions*) are caused by nerve currents which start in the cerebrum.

The nerve system works as follows: Something touches the hand. From a touch organ in the skin a nerve current

is sent over a group of nerve threads to the cells in the spinal cord with which they connect. These cells oxidize and send the current over another set of threads to certain brain cells. The brain cells oxidize and the touch is felt. These brain cells send the current to other brain cells and the thought occurs to move the hand away. A nerve current caused by the oxidation of certain cells in the upper part of the brain runs down a set of threads in the spinal cord to the height of the shoulder. There it sets off a battery of cells in the spinal cord which, by oxidizing, send currents through connecting nerve threads to the muscles that move the hand. The muscles contract and the hand moves. The time of this entire series of currents may be one eighth or one tenth of a second.

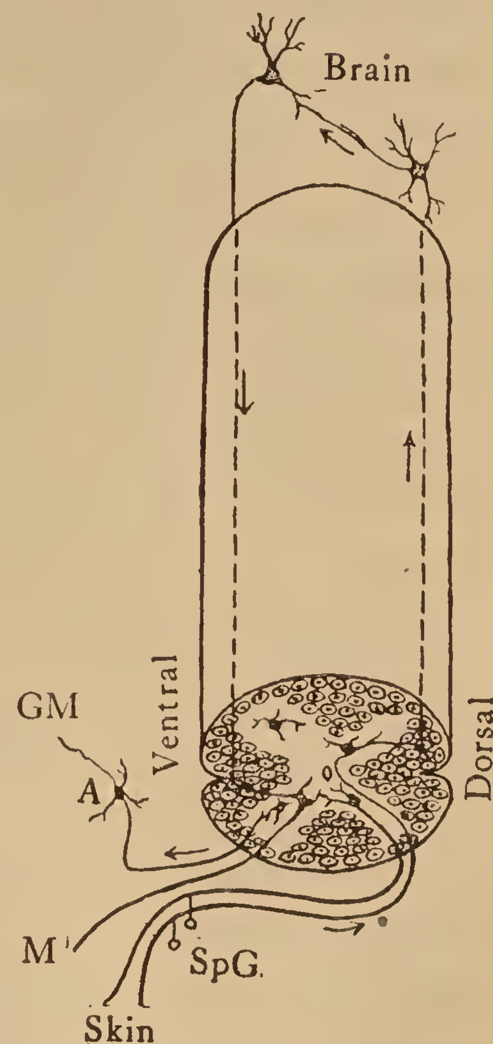


FIGURE 27. — SPINAL CORD.

This diagram shows paths of nerve currents coming from the skin to the cord and brain, and currents from the brain to the cord and thence to a muscle or to an autonomic ganglion, from which it goes to a gland or muscle. *GM*, gland or muscle; *A*, autonomic ganglion; *M*, muscle; *SpG*, spinal ganglion.

Involuntary Control. — In contrast to the voluntary movements are the involuntary activities, — the work of the digestive organs, the circulation of the blood, the secretions of the glands. These activities do not have their origin in the cerebrum but are controlled by a set of minor ganglia to which the term *autonom'ic* or *self-governing nerve system* has been applied. The autonomic ganglia constitute a chain lying on each side of the spinal column through the chest and

abdomen, together with three centrally situated groups — one in and near the heart, one behind the stomach, and one in the pelvis, the lower part of the abdomen. These ganglia are connected with the brain and spinal cord so that the nerve control of the whole body is unified. But although the brain unifies the control of these vital activities, no conscious effort of the mind can control them. A little thought will make clear what a wise arrangement this is, since no one could voluntarily control with success the beating of the heart, the work of the digestive organs, and other functions.

As an illustration of involuntary control take the muscular work of the intestine. When food is present in the intestine it starts off a nerve current to an autonomic nerve center. Stimulated by this current the center oxidizes, and sends out a current to muscles in the wall of the intestine, which are made to contract and force the food along. We not only have no control over this action but we are altogether unconscious of it.

Control through Hormones. — There is another sort of automatic control of the cells of the body, within a limited field, which acts by means of substances carried in the blood instead of by nerve currents. These substances are secreted by certain glands called *ductless glands,* because unlike the liver, pancreas, and salivary glands, they have no ducts to carry away their secretions. Consequently their secretions are absorbed in the lymph, carried into the blood and distributed to all parts of the body. These secretions are called *hor′mon-ēs.* The work of the hormones seems to be to influence the activities of the cells in certain parts or in all of the body. They are necessary not only to the perfect growth of the body but also to the wholesome development of the mind. Our good cheer, the degree of our courage, the persistence of our application to our work depend on the hormones. The following are the most prominent of the ductless glands:

The *thy'roid gland*, situated in the neck (enlarged in goiter), produces a fluid which stimulates assimilation of food. If it is poorly developed the child does not grow normally. If it is enlarged its effect may be disastrous in another way, resulting in nervousness and general breakdown.

A portion of the *pit'uitary gland*, which is situated in a small depression in the skull just beneath the brain, secretes a fluid that also has the power of stimulating growth. Its absence results in a dwarfed body. Too much developed, it may cause the enormous growth of the eight-and nine-foot wonders, or it may cause the bones of the head or hands to grow to a grotesque size.

The *adre'nal glands*, lying near the kidneys (see Figure 24, suprarenal glands), produce a substance which has a profound influence on the small blood vessels. In its absence the vessels become flabby and the blood does not circulate well. Present in too large quantities, it causes the vessels to contract so vigorously as to shut out the blood. An extract is made from the adrenal glands of the sheep and used by surgeons locally to drive the blood temporarily out of tissue where they are working, *e.g.*, the lining of the nose.

A good example of control through hormones is found during strong emotion. When one becomes very angry the adrenal glands produce an unusual amount of their secretion. This is quickly carried into the general circulation and tones up the whole body. The lungs take in more oxygen; the liver converts glycogen to sugar and pours this energy food into the blood; our general vigor is increased; we are ready for a fight. In like manner when we are moved by fear the increased adrenal secretion gives us greater power of flight.

Why is there need of a nerve system? Of what is a ganglion composed? What is a nerve? What is its function? Describe the course of the nerve currents which occur to make one feel a

touch on the hand. When you move your hand what nerve currents cause the act? Name some automatic activities. Where are the ganglia which control them? What are hormones? Name several ductless glands and describe the work of the hormones produced by each.

Section 8. Sensation

In the preceding section you saw how one part of the body is brought into harmony with another part that all may work in unison for the good of all. It is necessary also that the body be related to the world by which it is surrounded. It must be able to get from its environment what it needs and to avoid the things which would harm it. It can act on its surroundings by means of its muscles. How shall it get information about externals, and receive impressions that it may know how to act? Our special senses are the avenues of communication.

Special Senses. — The eye receives rays of light from the objects within our vision. The rays striking the nerve endings in the eye cause nerve currents to go to the brain — and we see. Vibrations of the air strike upon the ear and cause that organ to send nerve currents to the brain to give us hearing. When the skin is touched the tiny touch organs send nerve currents to the brain to make us feel. A particle of food on the tongue stimulates the taste organ to send nerve currents to the brain — and we taste. A minute particle carried by the stream of air into the nose touches the end of the nerve of smell and a current goes over the nerve to the cerebrum to give us the sense of smell. The function of a sense organ is to translate the impressions from the outside into a nerve current.

Besides the five special senses which have long been recognized, we now understand that the sense of heat and the sense of cold, residing in the skin, and the muscular sense, by which we distinguish between heavy and light weights when we lift them, are also special senses. Perhaps some

others should be added to the list. Our response to the world about us is quite imperfect. There are air vibrations too rapid and others too slow to arouse response of the ear. There are rays beyond the range of the eye. Our taste and smell are exceedingly limited. A touch may be unfelt. We have no organs to respond to magnetism and X-rays. Yet with our limited avenues of communication we are able to establish a wonderful connection with our environment, sufficient for the needs of the body.

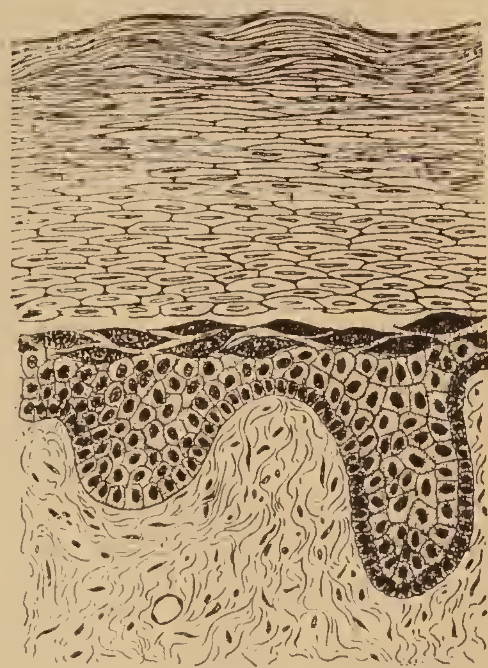


FIGURE 28. — THE EPIDERMIS.

The lower part of the figure shows fibers of the dermis. Examine the several layers of epidermis and tell how the upper cells differ from the lower.

Why need we have special senses? What is the function of the sense organs? Give three illustrations. Name eight special senses. Name as many things as you can which we have come to know by inference instead of by direct sensation.

Section 9. Protection

The Skin. — The skin protects the body against several kinds of injuries. Its main structure is a network of fibers which give it the qualities of elasticity, pliability, and toughness. The fat, which in some places is abundant in the skin, increases its efficiency as a pad to soften blows and to temper heat and cold. The surface of the skin is composed of dead, waxy cells which lap over one another like shingles on the roof. As the outside wears off new cells growing underneath are crowded to the surface and die, keeping a continuous hard and compact layer at the outside. This layer of dead cells is nearly impervious to gases, water, and germs, thus enabling us to handle poisons without being harmed. It also keeps the body from drying out rapidly. The protection which

the skin affords is increased somewhat by hair which all of us have in some quantity nearly all over the skin.

The Senses. — Through our special senses we are warned of the approach of dangers and are able to considerable extent to avoid them by the quick involuntary movements of the body. The eye winks when an insect flies toward it. The hand or foot jerks away when unexpectedly touched. But our mind is the preëminent agent in directing our lives away from dangers and in providing means for meeting harmful influences. You have already learned one way in which the body contends against disease germs that get into the body; the white blood cells in the blood kill the germs. Later we shall learn of other means of protection.

The avenues through which germs get into the body are somewhat guarded. The gastric juice kills many germs in the stomach, though too many get through and grow in the intestine. The nose passage, somewhat crooked and with an extensive moist surface, catches many germs before they can get to the lungs and gives us a chance to blow them out. In all these and some other ways the body protects itself, though quite imperfectly, against the dangers which assail it.

Of what is the skin composed? Against what does it protect us by its strength and thickness? What sort of surface has the skin? Against what does the outer layer of the skin protect us? For what purpose do you suppose the ancestors of man had hair well developed over the body while we have little need of it? Explain the value of the quick involuntary movements called reflex actions. Give several examples of man's protecting himself better than do other animals because of the superiority of his mind. How does the body protect itself against disease germs already in the body? How is the digestive tract to some extent protected against germs? How does the nose passage protect the lungs?

CHAPTER III

THE TREATMENT OF DISEASE

The birth of science was the death of superstition.
— THOMAS HUXLEY.

Section 1. From Superstition to Science

Old Superstitions. — It would never occur to anyone nowadays to go to a barber for a surgical operation. Yet for many centuries, and even until two hundred years ago, barbers were also surgeons. The barber pole is a very old symbol. Its alternate stripes represent the blood of the patient and the bandage of the surgeon.

The chief operation of these old barber-surgeons was the "letting of blood." For hundreds of years in all civilized countries the blood was supposed to be the source of all disease. A sick body was supposed to be "cleared up" by the removal of "impure blood," just as a tank might be cleaned by the removal of murky water. Even healthy people went in spring and autumn to be bled by the barber-surgeon as a precaution against disease.

We now know that the blood itself is actually attacked by comparatively few diseases. Far from being the source of most of our troubles, it is the veritable stream of life, and is vitally active in warding off disease or in the process of recovery from sickness.

Yet, strangely enough, the old ignorant beliefs as to "impure blood" survive to-day in various forms. Many children are dosed by their well-meaning parents in spring and

autumn with nauseous mixtures that are supposed to "thin" or "thicken" the blood. Patent medicine fakers advertise innumerable "blood teas," "blood tonics," "blood bitters," and "blood purifiers" as a means of remedying all sorts of diseases or of resisting contagion. Thus the makers of these useless nostrums thrive on the ignorance of thousands of people.

What is the meaning of the stripes on a barber pole? Why did people "let blood"? Discuss the use of "blood medicines."

Charms. — In olden times carved ivory images, stamped bits of metal, bits of parchments inscribed with magic words, and many other kinds of tokens were carried or worn as charms to ward off disease and misfortune. As late as 1820 in the United States, a booklet containing the weirdest kind of recipes for remedies and cures was widely circulated. Its brief preface promised the ignorant that whoever carried the book with him was safe from all his enemies, visible and invisible, and was immune to disease, drowning, burning, or unjust sentence of any court. These beliefs seem childish to us now, but many a man who would scoff at such superstitions is carrying a buckeye in his pocket to prevent rheumatism, or secretly cherishes the notion that the left hind foot of a rabbit or a "lucky" pocket piece is possessed of some sort of hidden virtue.

Give examples of the practice of wearing charms.

Mystery. — Mystery has always played a prominent part in the superstitious treatment of disease. Galen, the greatest of Roman physicians, taught that a prescription lost most of its virtue unless it was written in Egyptian. Great physicians of the middle ages included in many of their prescriptions "powdered horn of a unicorn." Yet the unicorn, like the modern sea-serpent, had never been caught. In modern times the manufacturers of "patent medicines" have played on this popular faith in mysterious

remedies. Many useless concoctions have been sold as the secret recipes of gypsies, the magic remedies of infallible Indian medicine-men or of Oriental priests, or as the inspired formulas of old women who have discovered the wonderful healing powers of rare herbs. Actually there is nothing mysterious about any of these nostrums; they are made of substances well known to any chemist and are often worse than useless.

Give ancient and modern examples of the appeal to mystery in medical practice.

Tradition. — There are many old traditions about food and medicines which are commonly believed, but have no ground in science. For example, it is said that you should not drink milk after eating sour fruit, lest it curdle in the stomach. The fact is that milk always curdles in the stomach — a desirable process. It is said that poisonous mushrooms tarnish a silver spoon while edible ones do not. The test is altogether untrustworthy. The use of medicines by physicians was until about a generation ago chiefly traditional, — and is still altogether too largely so. A drug was used because it was said by someone long ago to be helpful in the disease under treatment.

Explain how tradition leads to irrational practices in regard to health.

Pseudo-science. — There are several "schools of medicine," cults of healing, nature cures, etc., which affect to be founded on "science" but whose practitioners are very like the fakers who have always preyed on the ills of mankind. Some of these cults have a religious or semi-religious character. They all claim to heal when regular practitioners fail. They sometimes gain quite a following for a time, because they occasionally perform some striking cures. Their cures are of the kind that have throughout the ages been performed by miracle workers — cures of diseases

which arise out of disordered imagination. Such cults die out after a few years, to be followed by others of like ilk, founded on some new "discovery," but whose attainments are practically the same.

What cults of healing do you know?

True Science. — In contrast to all these superstitions, charms, mysteries, traditions, and false science is the truly scientific practice of the healing art. It is modest in that it recognizes how far short it falls of its ideals. It is candid in publishing its own failures. It is truly scientific in that it unrelentingly seeks the truth, regardless of the destruction of cherished theories, — it puts all things to the test and holds fast only that which is good. Medicines are no longer given by the best physicians because someone years or centuries ago said they were good for certain diseases. Every remedy must be tested in hundreds of cases. If it does not stand up under the test and prove its value it is thrown into the discard — the fate of a good share of the drugs in use two generations ago.

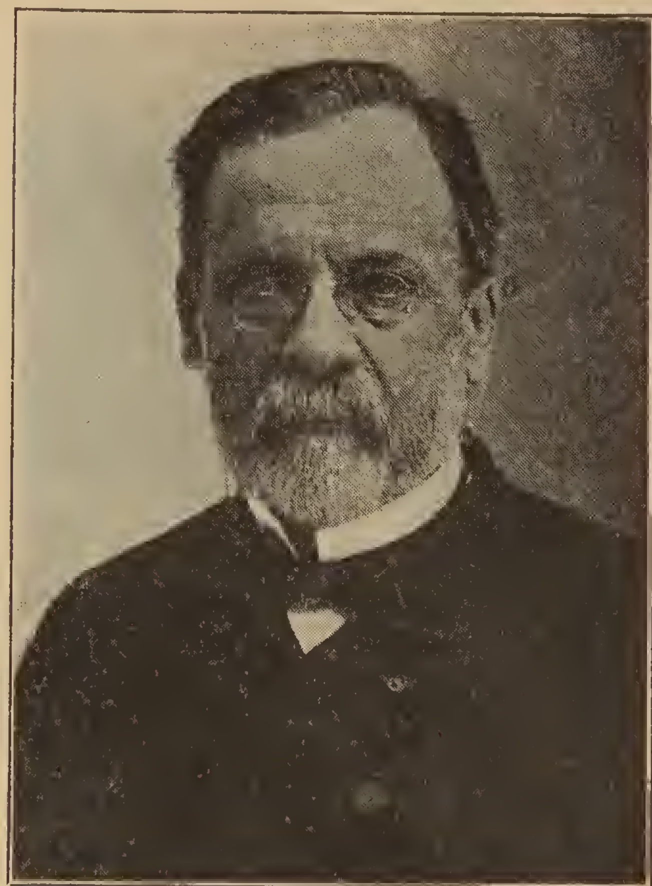
Explain how true science differs from pseudo-science in medicine.

Modern Miracles. — By such scientific methods the practice of medicine has made more progress within the last 75 years than in all the centuries of history. Within 50 years surgery has been revolutionized. Thousands of lives are saved daily that would formerly have perished. Operations that 50 years ago were rare and over 90 per cent fatal are now performed daily with very little loss of life. Torn and mutilated bodies are patched up and remolded in ways that would never have been thought possible a few years ago. Germ growths and their products that formerly would have resulted in death are now cut out and the patient made well and strong. Preventive or curative treatments have been devised which have well nigh robbed of their power a

number of diseases which used to bring consternation and terror to the communities in which they appeared, — rabies (hydrophobia), yellow fever, malaria, diphtheria, tetanus, typhoid, anthrax, smallpox.

What are some of the wonderful achievements of modern scientific medicine?

The Cornerstone.— All these wonderful advances in surgery and most of those in preventive and curative medicine have been built on the cornerstone laid by Louis Pasteur — the discovery that germs cause disease. The great English surgeon Lister was quick to apply this discovery to his field. He saw that if germs could be excluded from wounds the injury would heal quickly and without pus, and thus he laid the foundation of aseptic surgery. Methods of operating and of caring for wounds made such progress that in the late World War limbs that would formerly have been called shattered beyond hope of recovery, and lives



(Underwood & Underwood Photo)

FIGURE 29. — LOUIS PASTEUR.

This Frenchman (1822-1895) discovered the fact that germs cause diseases in domestic plants and animals and in human beings. He saved to France the grape and silk industries which were being destroyed by diseases of the vines and of the silk worms. By devising cures and preventive treatments for chicken cholera, hog plague, anthrax, and rabies (hydrophobia) he has preserved the lives of domestic animals to the value of hundreds of millions of dollars and saved the lives of thousands of people. On the foundation he laid rests the science of modern medicine.

that would have been given up were saved by the thousands.

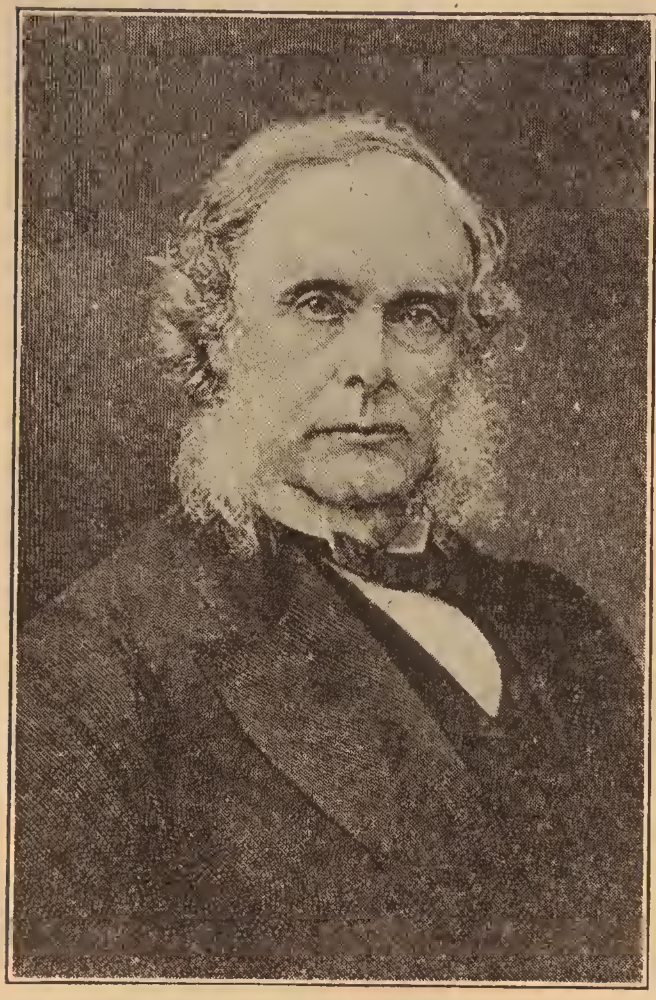


FIGURE 30. — SIR JOSEPH LISTER.

This Englishman (1827–1912) has been called the father of modern surgery. He taught the need of cleanliness in surgery even before Pasteur proved the existence of putrefactive germs. He was quick to appreciate the value of Pasteur's discoveries, and, enlightened by them, devised methods of aseptic and antiseptic operations which made possible the wonderful accomplishments of modern surgery.

What is the cornerstone of modern medicine? How has this been applied in surgery?

The Royal Road. — The highway that has brought the art of preserving health and healing the sick to the advanced stage it has reached has been the royal road which leads to every success, — devoted, painstaking, scientific work. Earnest men have not only spent their lives in seeking the truths which would alleviate the sufferings of their fellows, but they have offered their bodies for experiment and not a few have laid down their lives, martyrs to the cause of scientific medicine. Anyone who appreciates this sacrifice and recognizes the value of scientific work will not be willing to govern his life according to the superstitions or traditions of the past or the pseudo-scientific cults of to-day but will demand the most scholarly guidance of modern medical science.

How have the results of modern scientific medicine been achieved?

Section 2. Health and Sickness

Hygiene. — Keeping the body in good health is called *hygiene.* By good health we mean that the activities of the cells are going on normally, each organ doing the work it is fitted to do in the whole body economy. Since the human machine adjusts itself to its surroundings, manages itself and repairs itself, it will usually be in good working order unless it is too greatly abused. However, it has not perfect power of adjustment and repair. We must make the conditions under which it works as favorable as possible. This is the practice of hygiene. We can do it intelligently and successfully only when we understand the working of the body (physiology) as described briefly in the preceding chapter.

What do we mean by health? by hygiene? Why do we need to study physiology?

Sickness and Remedy. — Sickness is just the opposite of health, a condition in which some of the organs of the body are not doing their normal work. There are seven chief causes of sickness.

1. Sometimes the organ is imperfectly formed or has been injured by accident. An operation or course of treatment will sometimes improve the working of such an organ.

2. Sometimes the cells are inherently weak, unable to do their normal work or to resist influences which are always tending to destroy them. Inherent weakness is usually due to unfortunate heredity; that is, imperfection in the parents. In this case something can often be done by care in food, exercise, and rest, to increase the strength of the person of poor heredity.

3. Cells not inherently weak are sometimes weakened by over-activity so that they can not do their work. They usually recover when rested.

4. Lack of suitable food is also a common cause of illness. The remedy obviously is to supply good food. This requires sometimes a great deal of study to know just what is needed.

5. Poisons used in industry (lead, phosphorus) sometimes destroy or derange cells. The injury is serious, often fatal. Since little can be done to remedy such injury, attention should in this case be given to prevention.

6. Some people use harmful drugs to such an extent as to injure seriously the cells, especially of the brain. A glass of wine, a cigar, a few cups of coffee, a headache powder — all interfere with the natural working of the nerve cells and if used excessively may produce serious trouble. It is possible to stop the use of harmful drugs and recover from their evil effects, but it is much easier to avoid them than to break the habit of using them.

7. But the most common causes of sickness are the disease-producing organisms, — bacteria and other minute plants and animals.

What is sickness? Name seven causes of disease, and indicate which one produces most disease. In what various ways may disease or weaknesses be remedied? What difficulties are there in curing a disease due to lack of suitable food?

Parasites. — There are many small plants and animals which live within our bodies or on the surface. They are called *parasites* and many of them may cause disease. Some, like lice, fleas, mosquitoes, biting flies and ticks, which attack the skin, and the intestinal worms, are of size large enough to be seen easily. Others are so small that to see them individually we must use a microscope of high power. These are called *germs, mi′cro-or′ganisms*, or *mi′crobes*. The most common of the microbes are the tiny one-celled plants called *bacteria*. Each bacterium consists chiefly of a minute bit of protoplasm enclosed in its cell-wall.

Not all diseases are caused by microbes though many

have been proved to be so caused. Probably all diseases which one "catches" are due to microbes. In general each of these diseases has its own special germ, whose growth in the body causes that disease and no other. One kind of microbe causes diphtheria, another tuberculosis, another malaria, another typhoid; sometimes, however, more than one kind of germ may be present to cause the diseases of pneumonia, tonsillitis, dysentery, "cold," etc.

What is a parasite? Name several which infest the skin. What terms are applied to microscopic parasites? Discuss the causing of disease by germs.

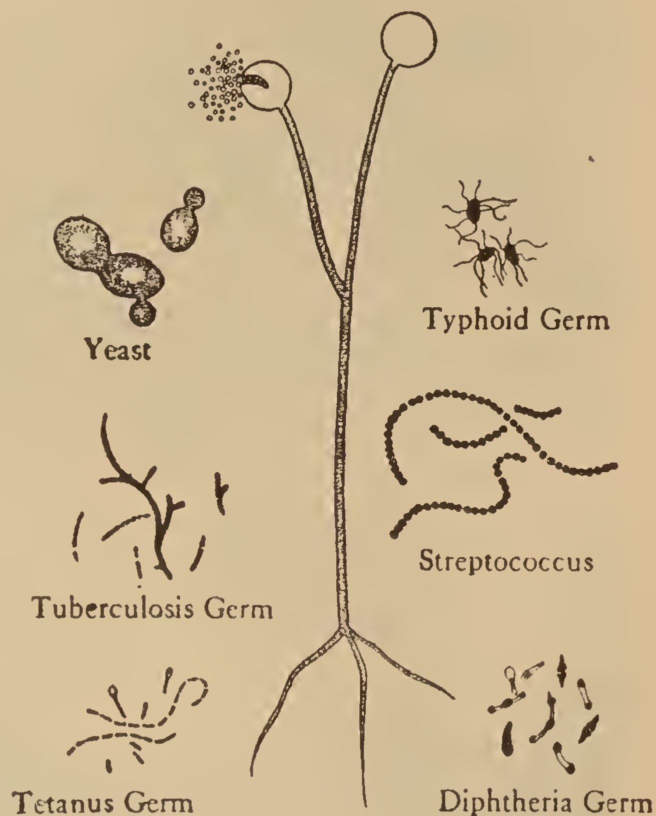


FIGURE 31. — MOLD, YEAST, AND BACTERIA (much magnified).

The mold is the tree-like form whose spores are produced in heads which break open and let the spores escape.

How Bacteria Are Studied. — Different kinds of bacteria, unless greatly magnified, can not be distinguished from one another. Under a high-power microscope some of them are easily distinguished from others, as you see in Figure 31, but there are some kinds that can not be identified even with the microscope.

These must be grown in the laboratory and studied for a day or two that their differences of behavior may be observed. Some will grow in almost any food substance. Others are so limited in their food that it is almost impossible to cultivate them. Coagulated blood serum and gelatine containing beef broth are common foods used. As the bacteria grow, some kinds cause the gelatine to liquefy,

others leave the jelly firm. Some kinds grow only at the surface where they can get the air, others only deep in the jelly shut away from the air. The color and the form of the mass of bacteria may identify them, as may also their rates of growth.

Why is it so difficult to study bacteria? How are they sometimes grown in a laboratory? What are some of the differences by which bacteria are distinguished?

How Bacteria Live. — The bacteria simply absorb the food on which they lie or in which they are immersed. As they assimilate the food they grow to their full size, then divide into two cells. When food is plenteous and the temperature favorable, bacteria can divide every half hour. At this rate a single bacterium in one day would multiply to an inconceivable number. Of course such a rapid growth is not continued for a long time, since the most favorable conditions can not long be maintained. While bacteria are growing rapidly they are tender and easily killed by heat, cold, sunshine, or drying. Most of them perish quickly in one of these ways.

Spores. — But bacteria can go into a resting stage, in which they lose some water and become denser. In this condition they are called *spores*, and have great resistance to unfavorable conditions. Germ-killing poisons do not so easily affect them. Freezing or drying does not kill them, and some can endure a temperature of almost boiling water. When a spore happens to get into surroundings suitable to its growth, it becomes an active cell again and assimilates food and multiplies.

Not all bacteria are known to form spores. Most disease-producing bacteria fortunately are of this number. Those which do not can be more easily killed when we can get at them in their active state. Moderate cold does not kill germs but it does stop their growth. Then, when they become warm again they resume their active growth.

What do bacteria do to grow? Figure out how many might be produced from a single cell in the course of twenty-four hours. What is a spore? What advantage is it to bacteria to form spores sometimes? What becomes of the spores? Why do we keep food in an ice box?

FIGURE 32. — EFFECT OF SOIL BACTERIA.

The clover plant on the left is growing in a poor sandy soil. The one on the right is a similar plant growing in a similar soil to which bacteria that enrich the soil have been added.

Beneficial Microbes. — We hear so much about disease germs that we sometimes get the idea that all bacteria are

our enemies. The fact is that microörganisms are our friends, indispensable to us. Only a few of them are disease-producing. Most decay is the work of microörganisms, plant and animal. If the leaves and sticks, dead plants and animals, did not decay there would be no room on the earth for the living. Soil is prepared for plants by the microbes in it. Cream is soured for butter, and cheese is ripened by certain bacteria. Yeast which makes bread rise is a minute one-celled plant.

Name as many ways as you can in which microbes are beneficial. What is yeast and what does it do?

Where Disease Germs Grow. — Disease germs are considerably limited in their place of growth. Diphtheria germs grow on the tonsils and adjacent parts of the throat; malaria germs, in the blood; tetanus (lockjaw) germs, in the wound into which they are introduced; typhoid germs grow at first in the intestine and are later spread by the blood. Tuberculosis bacteria may grow in any tissue though they are most common in the lungs. Smallpox germs seem to spread quickly through the body and to develop vigorously in the skin. The less active tissues, as bone, seem particularly susceptible to attack by leprosy germs.

Name several disease germs which are very limited in their place of growth, and give the location of each. Name some disease germs which spread through the body.

How Disease Germs Harm Us. — In some diseases (tuberculosis, leprosy) the tissue in which the germs grow is destroyed, making sores and cavities. In others the tissue remains intact but a poison (called *toxin*) is produced by the germs, gets into the blood, and so may be carried anywhere in the body. Tuberculosis bacteria destroy tissue and also produce a toxin. The nerve system especially is injured by the toxins. Tetanus produces a deadly toxin. Diphtheria produces most of its injury by means of its toxin.

Pus is one of the harmful results of the growth of many bacteria. It consists of lymph, a large number of white blood cells, and germs. It is usually whitish or yellowish, sometimes greenish (depending on the kind of bacteria), and pink when stained with blood. Pimples, boils, carbuncles, and smallpox eruptions are accumulations of pus in the skin. Accidental wounds commonly contain pus. Internal cavities — nose, ears, appendix, lungs — are often breeding places for pus-forming germs. Pus may contain a toxin.

Name disease germs which destroy parts of the body. Name germs which do injury by producing toxin. Of what is pus composed? Where may it be formed?

How the Body Protects Itself from Germs. — The skin is a fairly germ-tight covering. When it is unbroken germs can hardly get through. A few sometimes get into the oil glands and hair roots, and certain kinds can grow on the surface, but their injuries are commonly superficial. Most disease germs get in through breaks in the skin or through the natural openings — nose and mouth. The white blood cells, the policemen of the body, are aided in their work by the fluid of the blood which also has the power, to considerable extent, of killing germs. We have disease because these two germ-destroying factors are not perfectly efficient. The practice of medicine is much concerned in increasing the efficiency of these germ-killing agents.

The microbes which do their injury by the toxins they produce may be made harmless by counteracting the effects of the toxins. When the toxin is present in the body it stimulates the cells to produce a protective *antitox'in.* The antitoxin renders the toxin harmless. The germs can then be killed by the white blood cells.

An attack of smallpox makes it impossible, or at least very difficult, for an individual to contract the disease again. This is due to the fact that the body has acquired the habit,

so to speak, of manufacturing substances which render the attacks of that specific disease germ harmless. The protection this habit gives the body is called *immunity*.

FIGURE 33. — CHAULMOOGRA TREE, LEAVES AND FRUIT.

This tree, a native of eastern India, our Department of Agriculture is trying to introduce into America to supply an oil valuable in the treatment of leprosy.

What means has the body for keeping germs out? How do disease germs get into the body? How does the body fight against germs? What does an antitoxin do? By what and when is it produced? What is meant by immunity?

How We Can Cure Certain Diseases. — Since certain germs breed disease, the first suggestion is to kill the germs.

If this is done *safely* within or on the body the sickness is cured. There are some germ-killing medicines which can be taken in sufficient quantity to kill the microbes without seriously poisoning the body, but they must be used with great care, — quinine for malaria, preparations of the oil of chaulmoogra for leprosy, several drugs for intestinal worms, perhaps calomel for the germs that cause diarrhea.

How We Can Avoid Disease. — Important as is the cure of disease, prevention is much more important. The last few years have seen immense strides in the successful treatment of the sick and even greater progress in keeping people from getting sick. Yet the science of preventive medicine is still in its infancy. We may hope great things from it in the near future. Meanwhile there are many things we can do to avoid disease.

Germs on the surface of the body are seldom dangerous, but they should be washed off as thoroughly as possible. This is one of the great values of frequent baths and especially of washing the hands before handling food. Cuts or tears of the skin and the surrounding surface should be touched or "painted" with iodine to kill germs that might get in through the break. Germs discharged from the body of the sick should be destroyed by putting a germ-killing substance called *disinfectant* into the closet. Cloths and garments used by the sick, bed clothes, etc., should be disinfected before going to the laundry. The room itself should be disinfected by poisonous vapors, a process called *fumigation.* Drinking water, if suspected of containing germs, should be disinfected by boiling or by a chemical which kills the germs without spoiling the water. Cooking food kills the germs.

Besides killing the germs we can take pains to avoid them, — to keep food, drinking water, and ourselves as much as possible away from the sick or from the germs which come from them. We quarantine the sick and forbid those

known to have disease germs to handle food for others. One of the most important things we can do is to make ourselves

(Rundle-Spence Manufacturing Co., Milwaukee, Wis.)

FIGURE 34. — A SANITARY FOUNTAIN.

Germs of sore throat are often communicated by a common drinking cup. A fountain which is touched by the lips is unsanitary. This illustration shows the most approved style of fountain, with a slanting stream. The lips touch only the water, and the water falling from the lips carries any germs it may get away, not back into the fountain.

proof against the germs which may come to us. Though the germs of some diseases (influenza, pneumonia, smallpox) attack the vigorous as successfully as the weak, there

are other diseases (tuberculosis, for example) which those who are well fed and strong seem to resist. It pays to keep ourselves in good condition by hygienic living.

Some artificial processes protect us against certain diseases — vaccination against smallpox, anti-typhoid serum injections against typhoid fever, toxin-antitoxin injections (TA) against diphtheria. These means of acquiring immunity and their results will be described later.

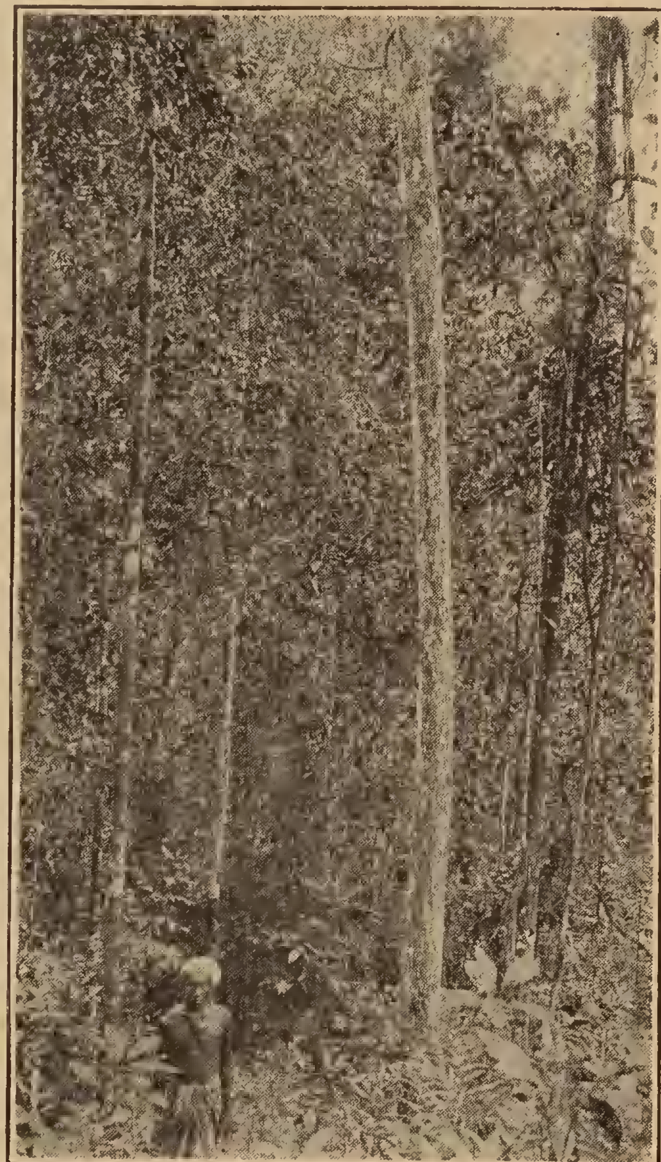


FIGURE 35. — A CHAULMOOGRA FOREST IN BURMA.

The problem of keeping healthy is partly an individual problem, concerned with things we do for ourselves to keep well, and partly a social problem, concerned with what organized society does for the health of us all. Under the latter head come such topics as water supply, sewers, food inspection, pure air, quarantine, etc. The word *sanitation* is commonly applied to these things.

Of the three methods of avoiding disease — killing the germs, keeping away from them, strengthening the body against them — which is most thoroughgoing? Why should a community practice all three methods at the same time? Name some medicines which are specific cures. Give a good reason for bathing frequently. Why should the hands be washed before handling food? Why should scratches and cuts be treated with iodine? What

is meant by disinfection? by fumigation? Why should the clothes of the sick be disinfected before going to the laundry? Name two ways in which drinking water is disinfected. What is quarantine? In what two kinds of ways can we fortify our bodies against disease? Can we protect ourselves against all diseases in these ways? What is meant by sanitation?

Summary. — We have seen that in health every part of the body is doing its work normally. In sickness some parts fail to do their work. Among the causes of this failure the most common is disease germs. In this chapter we have given only a general discussion of this topic. The details will be taken up in subsequent chapters.

CHAPTER IV

FOOD

They are as sick that surfeit with too much,
As they that starve with nothing.
— MERCHANT OF VENICE.

Section 1. Principles of Selection

First Principle. — There are several principles which should control us in the selection of food. *First, the food should contain the substances needed by the body.* We saw in Chapter II that any of the three kinds of foods — carbohydrates, fats, proteins — may be oxidized in the cells of the body to produce energy, but that carbohydrates and fats are best for this particular purpose. Protein foods are indispensable because, as has been shown, they are the only foods which contain all the elements necessary for the growth and repair of protoplasm. It is estimated that between one eighth and one fifth of our food should be protein; the remainder, carbohydrates and fats.

Mineral Salts. — The body also needs certain mineral substances. About one half of the bones is mineral — chiefly calcium (lime) compounds. Iron is found all through the body, particularly in the red blood corpuscles, the liver, and spleen. A few other minerals are needed for the blood and for other tissues. These minerals always occur in chemical compounds called *mineral salts.* They are available for our use in certain foods. Our supply of them comes chiefly from the vegetables we eat. Green vegetables especially contain iron salts. Milk and yolk of egg contain lime salts and other valuable mineral substances.

A varied diet of meat, milk, eggs, and vegetables supplies us with all the mineral salts we need.

Vitamines. — There are certain substances called *vi′-tamines* which are also indispensable. They occur in very small quantities in a variety of foods. We can not exactly define vitamines, but we know the effects of their presence or absence. If they are altogether excluded from our diet, we become sick and die. Restoring them to the bill of fare cures the sickness if it has not progressed too far.

There are three kinds of vitamines: one kind soluble in fat, called *Fat Soluble A;* and two kinds soluble in water, called *Water Soluble B* and *Water Soluble C.* All three kinds are necessary to health and growth. Fat Soluble A vitamines occur particularly in milk, butter, cheese, eggs, and leafy vegetables, such as spinach, and lettuce. Water Soluble B vitamines occur in milk, in almost all the commonly used vegetables, cooked or uncooked, and in the *whole grains* of wheat, rice, and other cereals. Water Soluble C vitamines are contained in largest quantities in fresh fruits and uncooked vegetables.

Cod liver oil is rich in A vitamines. Yeast, which has been so extravagantly advertised as a curative diet for many ills, is possibly the richest source of B vitamines. Orange juice and the juice of raw or cooked tomatoes furnish the C vitamines in abundance. Raw carrots, or very young carrots cooked for a short time, contain all three kinds. Coleslaw (commonly called cold-slaw), lettuce, and tomato salad, and almost all kinds of uncooked combination vegetable salads furnish the three kinds of vitamines. Meat also contains a small quantity of vitamines.

How much vitamine food we need, we do not know. It seems that after a certain quantity is taken, increasing the amount does no good. Therefore we do not need vitamines in all our food. We must only be sure to get enough, and this we can do by varying our diet sufficiently. An infant

gets its needed supply of vitamines, as well as of other food elements, from the mother's milk. In the case of bottle-fed infants, it is frequently necessary to supplement the milk diet with orange juice or tomato juice, since the modified and sterilized milk prepared for the baby contains only a very minute amount of any other vitamine than the A variety.

Second Principle. — *The food should be free from harmful substances and injurious organisms.* Among the harmful substances found in food are worm parasites, disease germs, the poisonous products of germ life (*pto'maines*), and substances which have narcotic or stimulating and other drug effects.

Third Principle. — *The food should be suited to our digestive organs.* Certain people can digest what others can not. Some persons must be careful to choose the food that digests most easily. In studies of digestion, "easy to digest" usually means "stays in the stomach but a short time" — perhaps an hour or two. "Hard to digest" means three or four hours in the stomach. The longer the food stays in the stomach the more chance it has to ferment and cause the suffering of indigestion. If we have no trouble with our stomach digestion (most of us who live hygienically do not) it makes little difference whether the food stays one hour or three hours in the stomach. Almost all healthy people can digest comfortably most common foods — which is a fortunate state of affairs. It is very inconvenient as well as unnecessary to be finical in our eating. We should study our eating until we know what we can eat and what we can not; remembering that we can probably eat what others do, and not letting our imagination blacklist a good food unnecessarily.

Fourth Principle. — *We have to consider, sometimes to our regret, the cost of the food.* Some of the foods best from the standpoint of hygiene are sometimes so high in price as to

tempt us to use a substitute which is cheaper but not so good for us. Butter is a much better food than oleomargarine because it is richer in vitamines. If we use the substitute which has so little vitamines we should take pains to get the necessary fat soluble vitamines from some

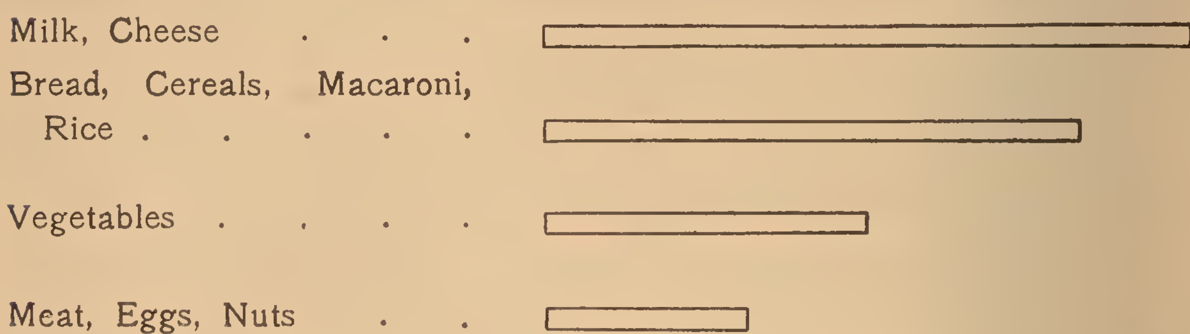


FIGURE 36. — COST OF GROWTH-FOOD.

The lengths of the lines indicate the relative quantities of growth-food which can be bought for ten cents.

other source. Some rather expensive foods, on the other hand, are no better hygienically than cheaper ones. Cheap cuts of meat are just as wholesome as expensive cuts. Fruits and vegetables out of season are not economical. By studying the problem carefully we shall be able to buy our food economically and yet not deprive ourselves of the things which are important in our diet.

State four principles which should control us in the use of food. Why is protein food indispensable? In about what proportions should proteins and carbohydrates or fats be used? What use does the body make of carbohydrates and fats?

What are vitamines? How is their absence from the diet manifested? What results from restoring them to the diet? Why are babies given orange juice? Is it more valuable for those nursed at the breast or for those fed boiled milk?

What harmful things sometimes found in food should we take pains to avoid?

What is meant by "easy to digest"? by "hard to digest"? What people should choose foods easy to digest? Why is it a matter of little concern to most of us? Why should most of us exclude a few and only a few good foods from our diet?

Why is it worth while for us to pay more for butter than for oleomargarine? How can we economize without detriment to our health in the use of meat? What is the most economical way to regulate our fruit and vegetable supply?

Section 2. Quantity

How Much to Eat. — We can not tell how much to eat by how hungry we feel. Hunger is so much a matter of habit that if we are accustomed to overeat we are still hungry when we have had enough; and if we are accustomed to eat less than we need we are satisfied when we have eaten less than we ought to take. A good rule is to eat as much as you need, and only as much as you need to keep up to your standard weight. No fixed standard can be set for everybody. Every adult should try himself out and learn at what weight he is in best health and can do his work most efficiently. Then he should eat so as to keep at about that weight, expecting to gain a few pounds between twenty-five and fifty years of age and to lose some in old age.

Tables have been made out showing the normal weights of boys and girls for each year of age and height in inches. Children that are much below normal (six or eight pounds is not serious for high school pupils; fifteen or twenty pounds is a matter of concern) should improve their diet and try to rise to the standard. Most high school boys and girls should gain one half pound to one pound per month if they are normal, and more than that if they are making up a deficiency.

Over weight means too much fat. Anti-fat medicines are worse than useless. Hard work will use up the fat, oxidize it. Eating little sugar and starch, the fat-producing foods, will prevent its recurrence. The best way to reduce is to eat less. Children over weight should be careful not to decrease their diet so as to interfere with their growth. If they are too fat they should stop eating candy and ice cream but not proteins.

Calories. — One's occupation governs largely the quantity of food needed. If a man works hard physically he must have much food to supply the energy. He can put out only as much energy as he takes in. Food energy is measured in *Cal′ories.*[1] A Calorie is the quantity of heat required to raise one kilogram of water one degree in temperature. A pound of food is said to contain as much energy as it would yield Calories when completely oxidized. A pound of fat contains about 4000 Calories, a pound of flour less than half as much. A hard worker will transform 4000 to 5000 Calories of food energy into work in a day; a clerk or a scholar 3000 or less. Small bodies use less than large ones. High school pupils commonly use between 2000 and 3000 Calories of food a day. A good lunch for you would contain about 500 Calories, — an egg sandwich 275 Cals., a glass of milk 150 Cals., and an apple 50 Cals. At dinner an average piece of meat will contain 200 to 400 Cals. and a potato 100 or 150 Cals.

Why is hunger an unreliable guide in eating? How much should one eat? What is your normal weight? Find your actual weight on a scale. If you are below normal what should you do? If an adult is too fat what should he do? Why should children be careful in following the same procedure? What should children that are too fat do without hesitation?

Why should a day laborer eat more than a bookkeeper? What is a Calorie? How many Calories a day does a hard-working man need? How many Calories does one of sedentary occupation need? How many Calories do you need?

[1] 1 Calorie = 1000 calories.

Inches high	Boys 12 Yrs.	Boys 13 Yrs.	Boys 14 Yrs.	Boys 15 Yrs.	Boys 16 Yrs.	Boys 17 Yrs.	Boys 18 Yrs.	Girls 12 Yrs.	Girls 13 Yrs.	Girls 14 Yrs.	Girls 15 Yrs.	Girls 16 Yrs.	Girls 17 Yrs.	Girls 18 Yrs.
50	62							61						
51	65							64						
52	68							67						
53	70	71						69	70					
54	73	74						72	73					
55	76	77	78					75	76	77				
56	80	81	82					79	80	81				
57	83	84	85	86				83	84	85	86			
58	86	87	88	90	91			87	88	89	90	91		
59	89	90	92	94	96	97		91	93	94	95	96	98	
60	93	94	97	99	101	102		95	97	99	100	102	104	106
61	97	99	102	104	106	108	110	101	102	104	106	108	109	111
62	102	104	106	109	111	113	116	106	107	109	111	113	114	115
63	107	109	111	114	115	117	119	111	112	113	115	117	118	119
64	113	115	117	118	119	120	122	115	117	118	119	120	121	122
65		120	122	123	124	125	126	117	119	120	122	123	124	125
66		125	126	127	128	129	130	119	121	122	124	126	127	128
67		130	131	132	133	134	135		124	126	127	128	129	130
68		134	135	136	137	138	139		126	128	130	132	133	134
69		138	139	140	141	142	143		129	131	133	135	136	137
70			142	144	145	146	147			134	136	138	139	140
71			147	149	150	151	152			138	140	142	143	144
72			152	154	155	156	157				145	147	148	149
73			157	159	160	161	162							
74			162	164	165	166	167							
75				169	170	171	172							
76				174	175	176	177							

There should be a gain each month		Boys	Girls
Age, girls 11 — boys	12 to 14	12 oz.	12 oz.
girls and boys	14 to 16	16 oz.	8 oz.
girls and boys	16 to 18	8 oz.	4 oz.

Section 3. Articles of Diet

In the preceding sections we have discussed the principles by which we choose our food and determine its quantity. We shall now take up various foods in detail.

Vegetarians. — The vegetarian, unless he uses milk products and eggs, contends that we should get our protein altogether from vegetable food and should use no meat or fish. Millions of people in the world do get adequate food without the use of meat. But with our customary foods, planned as they are for a meat diet, the vegetarian can not get along well by simply not eating the meat and taking the remainder of the menu. He should have protein foods to take the place of meat. These he commonly secures by eating beans, peas, or lentils. But these vegetable proteins are harder to digest than is lean meat. Though beans cost less than beef, a well balanced vegetable diet is about as expensive as a diet containing meat.

Milk and Eggs. — Milk and eggs are all-round foods, supplying energy as well as materials for growth. To the vegetarian who has no objection to using them, they furnish a good substitute for meat. When properly prepared they are easily digested. Milk, even at the present high prices, is more economical than meat, and most of us might profitably use more of it and less meat. Eggs cost nearly the same as meat, often much more. Though milk forms the sole nourishment of young mammals, and eggs contain the sole food of unhatched birds, these foods should be supplemented by other common foods in the diet of adults and of children over six or eight months of age.

Cereals. — In the temperate zone cereals, usually made into bread, form mankind's great staple food. They are mainly carbohydrates or energy foods, though with the exception of rice, they contain a notable quantity of protein. They must be supplemented by foods richer in nitrogen such as meat, milk, cheese, or beans. The great points in

their favor are economy and digestibility. Whole wheat bread, as has been shown, contains more of the mineral salts used in the body and stimulates bowel movements more than does white bread, and is therefore preferable for most of us. Brown rice (unpolished) contains a vitamine necessary to those in India who make it their staple food. If they use the polished rice of commerce they become sick

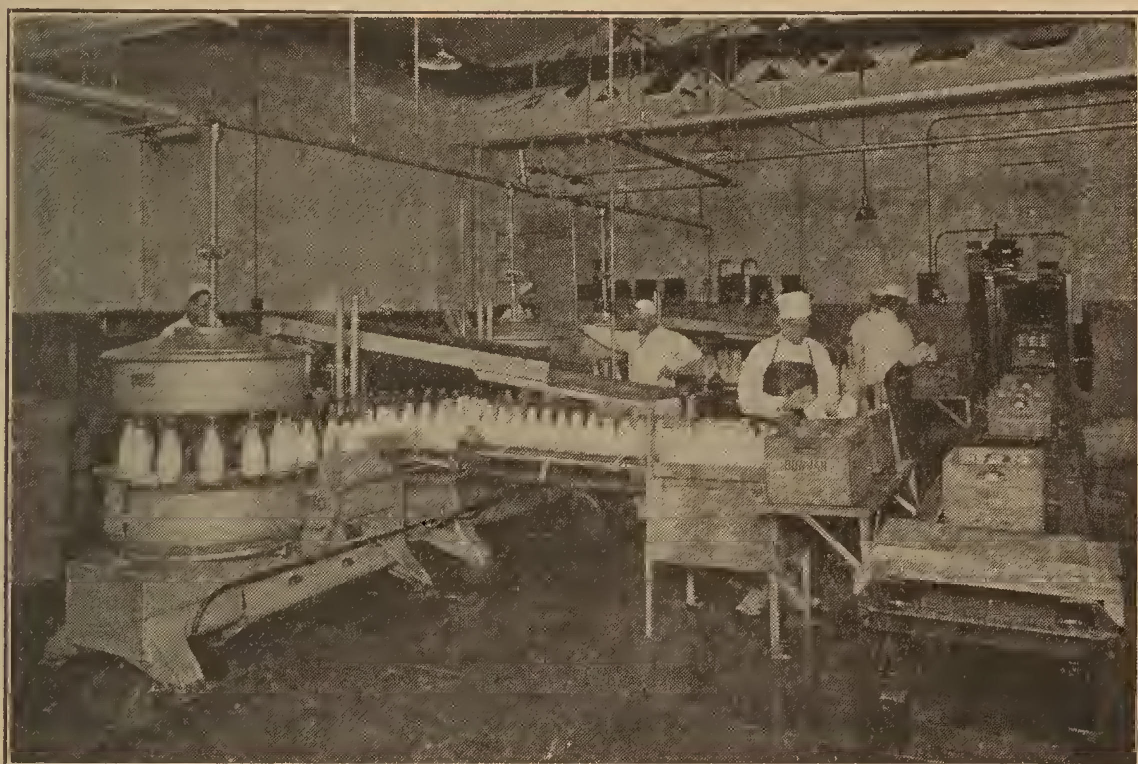


FIGURE 37. — INTERIOR OF MILK STATION.

After being Pasteurized and cooled the milk is bottled and capped by machines and stored in the refrigerating room until it is shipped.

and die. Though some of us like the brown rice, the polished grain is a good food for us since our varied diet gives us plenty of vitamines from other sources. Among the cereals other than rice there seems to be little to choose, so far as nourishment goes, wheat having a slight preference.

Vegetables. — Vegetables, especially green vegetables, notably cabbage, spinach, chard, lettuce, onions, tomatoes, cucumbers, carrots, turnips, are valuable sources of vitamines and of mineral salts. Practically all vegetables con-

tain protein, but their chief food constituents are sugar and starch. Nearly all are beneficial in providing *cel'lulose* (their cell walls) which does not digest but makes bulk in the intestine and so facilitates bowel movement. Potatoes have long been the favorite vegetable in Europe and America because of their economy, their vitamines, and their multiform preparations.

Fruit. — Fruits, fresh or dried, raw or cooked, are recommended for daily use. The acid which most of them contain is a stimulus to the digestive organs. They contain some cellulose, a little protein and commonly sugar. Several fruits, as oranges and grapefruit, contain valuable vitamines. Bananas contain some starch (much when green) and if eaten raw are sweeter and more easily digested when dead ripe. Some of the dried fruits have a high energy value: raisins contain much protein in addition to the sugar.

What is a vegetarian? Why need he give more thought to his diet than meat eaters give? How does a vegetable diet compare in cost with a meat-containing diet? How compare in vitamines? What is the vegetarian's best substitute for meat?

What form mankind's staple energy food? What are the points in their favor? What cereal is most used by the most progressive peoples? Why is whole wheat better than white bread for many people? Why should the natives of India use brown rice instead of polished? Why is it of less importance which we use?

For what are vegetables particularly valuable? Why is considerable cellulose in food desirable? Why are children urged to eat spinach or chard? Why are potatoes used so much in temperate climates?

For what are fruits particularly valuable? When fresh fruits are expensive what may be substituted with about as good results? Why should people with poor digestion eat bananas only when the fruit is thoroughly ripe?

TABLE OF FOOD VALUES

(approximate)

Foods As Purchased	Protein Per Cent	Fat Per Cent	Carbohydrates Per Cent	Calories Per Pound
Bacon	10	60	0	2400
Beef, fat	15	20	0	1100
lean	19	8	0	700
Fowl	14	12	0	750
Ham, smoked	17	18	0	1000
Liver	20	3	2.5	540
Mutton	14	23	0	1200
Pork chops	13	24	0	1200
Salt pork	2	86	0	3500
Turkey	16	18	0	1000
Veal	16	6	0	500
Fish, entire	11	4	0	360
steak	15	4	0	460
Oysters	9	2	4	330
Butter	1	85	0	3500
Buttermilk	3	1.5	5	160
Cheese, cream	26	34	2	1900
Cottage cheese	21	1	4	500
Eggs	12	9	0	600
Lard	0	100	0	4000
Milk, whole	3.3	4	5	300
Baked beans	7	2	20	600
Beans, dry	2	2	60	1600
Boston brown bread	6	6	54	1300
Corn meal	9	2	75	1600
Cracked wheat	11	2	75	1600
Oatmeal	16	7	67	1800
Rice	8	0	79	1600
Rye flour	7	1	78	1600
Wheat flour	11	1	75	1600
White bread	9	1	53	1100
Whole wheat flour	14	2	72	1600

TABLE OF FOOD VALUES

(approximate)

Foods As Purchased	Protein Per Cent	Fat Per Cent	Carbohydrates Per Cent	Calories Per Pound
Asparagus	2	.2	3.3	100
Beets	1	0	8	160
Cabbage	1.5	0	5	120
Carrots	1	0	7	160
Cauliflower	2	.5	5	140
Green corn	1	.5	8	180
Green peas	3.5	.2	10	250
Lettuce	1	0	2.5	70
Onions	.5	0	9	200
Potatoes	2	0	15	300
String beans	2	.3	7	180
Sweet potatoes	1.5	.5	22	450
Tomatoes	1	0	4	100
Apples	.3	.3	11	200
Bananas	1	.5	14	300
Grapes	1	1	14	300
Oranges	1	0	8	170
Pears	.5	.5	13	260
Watermelon	.2	0	3	60
Almonds	11	30	10	1600
Black walnuts	7	15	3	780
Brazil nuts	8	34	3	1600
Chestnuts	5	4.5	35	900
English walnuts	5	17	4	860
Chocolate	13	48	30	2800
Cocoa	21	29	38	2200
Prunes	2	0	62	1160
Raisins	2	3	68	1400
Sugar	0	0	100	1800

The sum of the per cents of proteins, fats, and carbohydrates subtracted from 100 gives the per cent of water, ash (mineral), and refuse. The mineral matter is always small, usually a fraction of one, though sometimes two or three

per cent. But it is a valuable part of the food. To find what part of the net food in any article is protein or fat or carbohydrate we must first eliminate the water and refuse. Then we must add together the three items and divide each by the sum. Thus in the case of milk the sum of the three items is 12.3. Dividing 3.3, 4, and 5 each by 12.3 gives nearly 27 per cent protein, 32 per cent fat, and 41 per cent carbohydrate.

1. What per cent of the net food (eliminating water and refuse) of lean beef is protein? is fat?

2. What per cent of the food of pork chops is protein? is fat?

3. Which of these two foods supplies more material for growth? Which supplies more energy for work?

4. About what per cent of the net food of cereals is protein?

5. About what per cent of the net food of potatoes is protein?

6. About what per cent of the net food of grapes is protein?

7. About what per cent of the net food of English walnuts is protein?

8. From foods of which group (meats, cereals, vegetables, fruit, or nuts) do we get most of our protein?

9. Is the protein of the net food of fresh vegetables higher or lower than of cereals?

10. To get much protein from fresh vegetables should we need to eat a large or a small quantity?

11. From what dry food would a vegetarian get a large per cent of protein?

To get the relative cost of energy in the various foods find the number of Calories which can be bought for one cent, by dividing the number of Calories in a pound by the cost of the pound.

12. At 25 cents a pound how many Calories do you get for a cent in buying lean beef?

13. At 4 cents a pound how many Calories do you get for a cent in buying wheat flour?

Compute as far as you can the number of Calories you get for a cent in each item of the table.

14. In what foods do you get most energy for a cent?

15. To what group do the most economical foods belong?

16. What expensive foods would you avoid when you have little money to spend?

17. Foods of which of the three classes have the highest energy value? Give several instances from the table.

18. Make out a bill of fare for dinner in which about one eighth of the food shall be protein and the total Calories about 1500 for each person. Compute the cost.

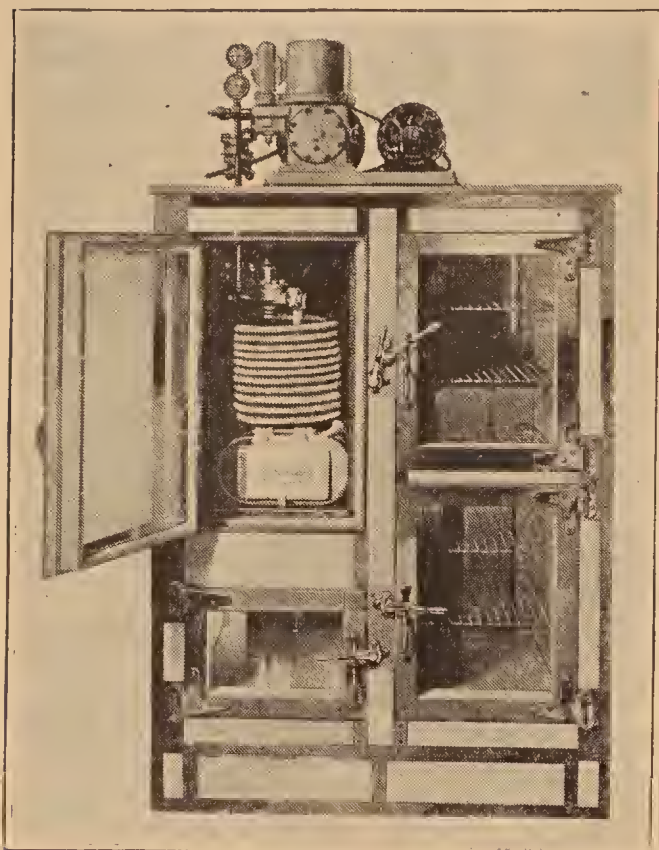


FIGURE 38. — A FOOD PRESERVER.

This refrigerator is cooled by an electrically driven automatic freezing machine instead of by ice. Although the original cost is considerable, the operation is much cheaper than the cost of ice and a lower temperature is maintained.

Section 4. Care of Foods

We study the care of food chiefly that we may know how to keep it from decaying and from becoming contaminated by disease germs. The common methods of preserving food are refrigeration, cleanliness, canning, and drying.

Refrigeration. — The cold temperature of a refrigerator does not kill the germs which have got into the food, but it does prevent their growth. If food is kept continuously at a temperature below freezing it can be preserved many months without deterioration. Some foods (fruit, potatoes, vegetables) will not stand freezing and must be kept at a little higher temperature. In the packing houses beef is usually kept at a temperature (about 35° Fahrenheit) which prevents decay although it allows mold to grow on the surface. At this temperature the meat becomes more tender.

If meat is held in storage several months it is kept at a temperature of 8° below zero. Sheep carcasses and game are transported half around the world frozen stiff. If milk is drawn with care to avoid germs and immediately cooled it may be kept a week without souring.

FIGURE 39.—PACKING HOUSE WORKERS.

Girls who handle meat in the canning and carton packing rooms must have clean hands and carefully manicured nails. The forelady inspects them at intervals during the day.

In the ice box, which should be a part of the equipment of every kitchen, food may be preserved for days when it would otherwise spoil in a few hours of summer heat. The efficiency of the refrigerator depends on its temperature. The colder it is, the better and longer it preserves the food. If the ice is allowed to melt down to a small piece the temperature goes up and the germs multiply. A refrigerator

cooled by ice can not be kept at a temperature low enough to prevent the growth of mold, yeast, and certain bacteria. These organisms, spoiling the food and giving rise to unpleasant odors, make it necessary to scrub out the refrigerator occasionally — particular housekeepers will do so once a

FIGURE 40. — MILK RECEIVING STATION AT PALATINE, ILL.

The cans in the wagons are covered to keep them from getting hot and dusty on the road to the station. The cans are washed and scalded before they are returned to the farmers.

week. Refrigerators cooled by ammonia pipes can be made so cold that no germs can grow in them.

Cleanliness. — This applies to both utensils and hands. Our laws relative to handling food are becoming more strict. Packing houses and canneries must provide conveniences for their employees to scrub their hands. Utensils are thoroughly washed and steamed to kill germs. Flies must be kept out. Goods must not be exposed on street stands

to miscellaneous handling, to dust, and insects. In some states, meat carcasses in transportation must be encased in cloth to keep them from contamination.

The care of milk has made most noteworthy progress within the last few years. In the best dairies the milkers

FIGURE 41. — A SANITARY COUNTER.

What device has this market to prevent untidy people's handling food others are to buy?

not only wash their hands but also put on clean jackets and overalls when they go to milk. The cows are brushed and their udders sponged clean. The milk pail has a cover with only a small opening protected with gauze, through which the milk but not the dirt can go into the pail. The milk is carried at once from the stable to the dairy and cooled — or *Pasteurized*[1] (pas-tėr'īzd) and then cooled — and kept

[1] See next page.

cool until it is used. No one is allowed to work about the milk if there is infectious disease in his family. Bottling the milk in the country as soon as it is Pasteurized or cooled is a great help in keeping it clean.

Certified milk is that produced with unusual care; it bears the certification of an inspector. The cows and dairy workers are inspected to see that they are free from disease. The food of the cows, the stables, the dairies, and bottling works must all be kept in first-class condition. The extra work, supervision, and inspection make a higher cost in the production of certified milk.

People having any infectious disease should not handle the food for others. Various diseases are often communicated by such handling. Typhoid fever is commonly transmitted by the untidy hands of a cook who harbors the germs.

Canning. — Foods are preserved by several processes whose purpose is to kill the germs in the food and prevent others from getting in. Fruits, vegetables, and meats are heated till they are thoroughly sterile and then put in tight cans to prevent other germs getting access to them. The housewife sometimes complains of bad luck in putting up fruit. It is a matter of science, not luck. If the fruit is put in sterile jars and while boiling hot closed air-tight with sterilized covers it can not spoil.

Factories seal the food in the cans and heat it to a temperature above boiling. This is accomplished by placing the cans in an air-tight boiler and turning on the steam, thus heating them under pressure. This extra heat insures the destruction of germs and, if there is no leak in the can, will preserve the food for years. Pressure heaters are manufactured for domestic use also. There is one disadvantage in this higher temperature; it may be destructive of certain vitamines.

Pasteurization of milk is a modification of this process. The milk is heated to between 140 and 160 degrees F., then

bottled. This temperature will kill common disease germs but not the spores of the germs which cause the milk to sour. Heating to a temperature high enough to kill the spores would destroy the vitamines and perhaps otherwise detract from the value of the milk. Without a thermometer milk can be Pasteurized fairly well in the home by putting a bottle of milk in a tall kettle of water, a little dish under the bottle to keep it off the bottom, and water within an inch of the top of the bottle. Bring the kettle of water to a boil, and then take it off the fire. The milk will be heated sufficiently to kill disease germs. Cool the bottle of milk rapidly and keep it on ice.

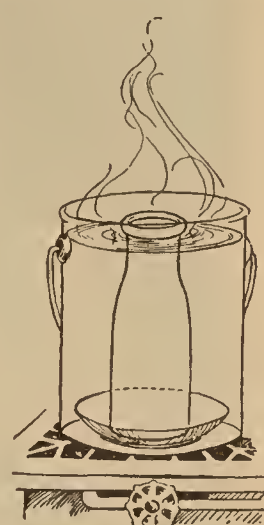


FIGURE 42. — HOME PASTEURIZING.

"**Curing,**" **Drying, Preserving.** — Salt and sugar, though wholesome when used dilute or in small quantities, are destructive agents when applied in a concentrated form. They absorb the water from protoplasm and destroy the cells. Therefore they can be used to kill the germs in food and so prevent its spoiling, and they do not make the food unwholesome. In the smoke of wood fire there is an antiseptic substance (*creosote*) which kills the germs on the surface of food that is hung in the smokehouse. Meats and fish are salted and smoked to kill germs present and to keep others from growing.

The process of drying makes the surface of meat so hard and dry that germs can not grow on it. Many fruits and vegetables also are preserved by drying. People, civilized and savage, nearly everywhere use this method of preserving foods. Lately improvements in the process have made the product more sanitary and attractive. In the modern process vegetables are shredded, kept under cover and dried by artificial heat, that the process may be rapid and cleanly. The product is packed in tight cans. It not only will keep but it is also light for transportation. These desiccated

vegetables are wholesome and tasty as well as convenient. It is thought, however, that vitamines are destroyed by the drying process.

Brines are used to preserve some meats and vegetables.

FIGURE 43. — BREAKFAST BACON.

These workers are packing "issue bacon" for the army. During the war the bacon section of the packing department of Armour and Company was kept busy 24 hours a day, and packed millions of 12-pound tins of bacon, cured and cut according to government specifications.

In jams and jellies so much sugar is used that bacteria can not grow below the surface, but mold grows freely if the surface is exposed. If a thin layer of the jelly is removed with the mold, the remainder of the jelly is unaffected. Hot paraffin poured over the surface to seal the jelly as soon as it is cold prevents the growth of mold.

What is the aim of caring for food? How does refrigeration preserve food? Why are live cattle and sheep not extensively

transported to Europe for food as in former years? Explain how an ice box in the kitchen is a means of economy. What care should be taken of the refrigerator?

Why is it so important to keep food clean? What provisions are made by law for food cleanliness? Why should such special care be taken to keep milk clean? What is certified milk? Why should it cost more than other milk? Why are people who have an infectious disease forbidden by law in some states to work in restaurants or packing houses? What disease is often communicated by an untidy cook?

How does canning prevent food's spoiling? Why is factory canned food more likely to keep than home canned? What is Pasteurization of milk? Why do some city ordinances require Pasteurization? Describe a process of home Pasteurization.

How does salting preserve meat and pickles? How does smoking and drying preserve foods? Why is it not necessary to close jams and jellies in air-tight jars while boiling hot? Why is melted paraffin poured over the cold jelly? What microörganism sometimes grows on the surface of pickle vats and jelly?

Section 5. Cooking

Reasons for Cooking. — There are several purposes in cooking food. First, tough meat and vegetables and the starch in many foods are softened and made more digestible by cooking. If left uncooked much of the food would go through the digestive tract undigested. To cook meat and vegetables by boiling we need only sufficient water to cover them. But dry starchy foods, like cereals and beans, soak up two to four times their bulk of water, and can not soften sufficiently without it.

Second, germs are killed in cooking. Sometimes a pig infested with *trichi'na*, a small worm, is butchered and marketed. If the meat is not well cooked the eater may contract the disease and die. Notwithstanding the government's inspection, we can not trust raw pork. It must be thoroughly cooked. More often beef and pork contain tape worms, which are killed by cooking. The disease-

producing bacteria are still more common in meats but they are easily killed at a temperature less than boiling.

Third, the taste and appearance of much of our food is improved by cooking, especially by the combinations we make and by the sauces and dressings. The more appetizing the food the more it stimulates the production of digestive juices and so the better it is digested.

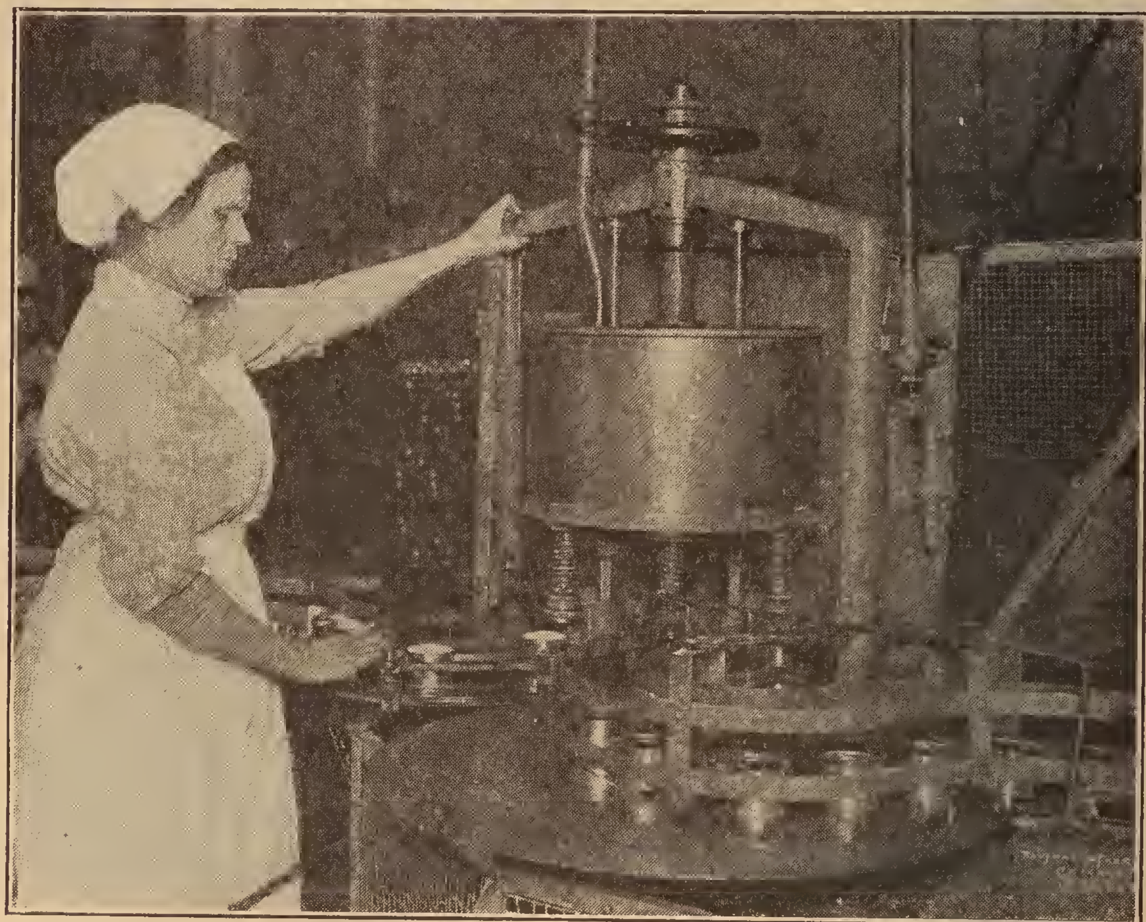


FIGURE 44. — PORK AND BEANS.

This woman is packing pork and beans in one of Armour and Company's plants. The filling and capping is done by automatic machinery.

Some foods (milk, eggs, tender meat) digest better uncooked. They should be cooked just enough to make them acceptable to the taste and to kill germs. Most cooked foods are softer than they would be raw and give our teeth less work in chewing. Our teeth would probably be rubbed and polished and so kept freer from the bacteria which cause decay if we ate most of our food uncooked so that we should

have to chew it much more. The pressure on the teeth which comes in vigorously chewing firm food is thought to keep the roots also in better condition, less subject to abscesses and pyorrhea. The chewing of apples, hard crusts, tough meats, etc., furnishes desirable exercise for the teeth.

As to the methods of cooking, the cook-books are usually an adequate guide. There are only a few hygienic points to touch. Objection is frequently made to frying in grease. One reason for this is that the grease coating keeps the watery digestive fluids off the food and retards digestion. If you find that fried foods distress you, don't eat them. If you like them and they give you no discomfort they will do you no harm. Eggs improperly fried are likely to be leathery. If you like them fried learn to cook them soft and tender.

There is no adequate reason for prescribing four or five hours' boiling for any cereal. Experiments on their digestibility indicate that thirty or forty minutes' cooking (some good authorities say less) renders them as digestible as three or four hours.

It is a fad nowadays to boil vegetables in so little water that it can all be used in sauce or soup. This preserves the salts and sugar which might otherwise be thrown away. It may be that some people profit by using these salts, but it has not been shown that we need more than we get by the old method.

The reason for the rule that condiments should be used sparingly in cooking and also on the table is that the condiment covers up the natural flavor of the food, so we miss the pleasure and digestive stimulus we should get from the many tastes of the various articles of diet. Strong condiments like mustard and pepper injure the sense of taste and irritate the lining of the stomach.

The cooking which makes the food attractive and appetizing is usually the best. If the food seems to produce

indigestion we should study our way of eating, the quantity and quality of the food and our general method of living before we blame the cooking. Such a simple thing as more chewing might remedy the evil.

Give three good reasons for cooking food. Why do starchy foods need more water in cooking than do meats and vegetables? What ground is there for the saying that the cook-book is making us toothless? Explain how an egg can be properly fried. How long does it take a cereal to cook? On what grounds do people advocate using the water in which vegetables are boiled? Why should we not get the habit of using condiments freely?

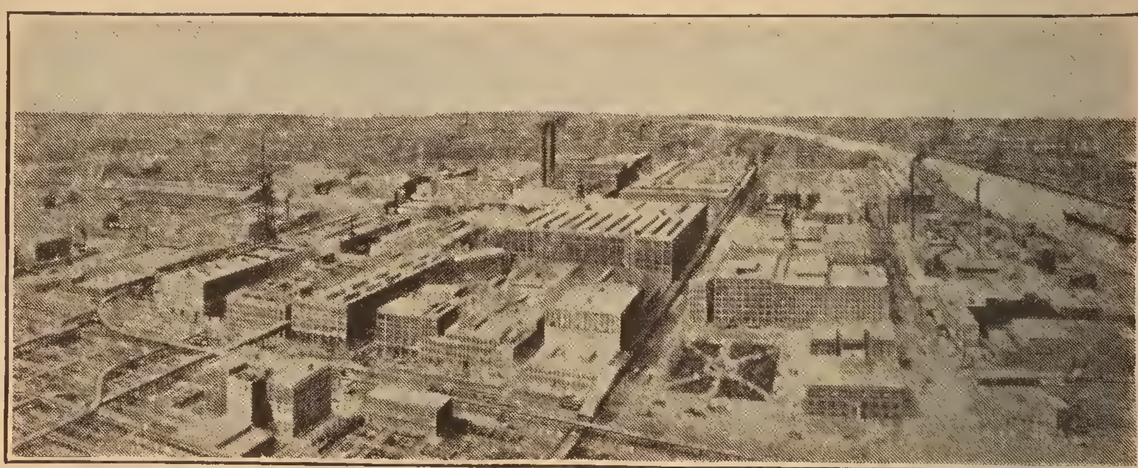


FIGURE 45.— PACKING HOUSES.

This is a panorama of Armour and Company's Chicago plant in which the slaughtering and dressing of meat animals and the curing and processing of meat take place.

The subject of food has been so much mistaught by people ignorant of the principles which should control its use that we find it difficult to separate the chaff from the wheat in the precepts we hear. "People eat too much" is true of many well-to-do families. But the children of the poor, a large per cent of our people, do not get enough to eat. "Fruit is golden in the morning, silver at noon and lead at night" is nonsense. Fruit is wholesome at every meal. We should bring all such sayings to the test by seeing how they conform with the principles taught in this chapter. Even then we can not always decide. Each of us must try

out in his own life the use of a food in question and determine by a careful study whether it is good for him. The principle that what is good for most people will probably be good for us is a good starting point. We must be careful not to let our taste or our fancy override our judgment. When we have found what agrees with us we must not insist on prescribing it for everyone.

Diet for the sick is too difficult a subject for this book. The physician, not some ignorant busybody, should give the directions. Many quacks are now making a fad of dieting to cure all sorts of ills. In so far as their prescriptions are guesswork or inspirations of the imagination they are worthless. Only the most carefully tested scientific studies are of any value, and the results of these can be secured only from registered, reputable physicians.

Make a list of all the precepts or sayings about diet and eating that you get and point out the sound, and the irrational features of each. How can a person in health usually make a sensible decision about his own diet? Discuss the saying, "What is one man's meat is another's poison." Give illustrations of its truth. What suggestion would you make about the diet of the sick?

CHAPTER V

STIMULANTS AND NARCOTICS

O thou invisible spirit of wine, if thou hast no name to be known by, let us call thee devil.

— OTHELLO.

The use of tea, coffee, wine, and beer with our meals has resulted in so much ill health and suffering that we need, in connection with our study of foods, to clear up misunderstandings of the matter. Some of these beverages are *stimulants* and others are *narcotics*.

What Stimulants and Narcotics Are. — A *stimulant* is a substance which increases the activity of organs or cells. A *narcotic* decreases such activity. Both act on the nerve system more than on other tissues. Some drugs have both stimulating and narcotizing effects. For example, a spoonful of alcohol, taken in the form of wine or whisky, causes the heart to beat faster for a few minutes and quickens the imagination. But after the first effect has passed both the mental and the muscular activities are slowed down.

What is a stimulant? What is a narcotic? What tissues do stimulants and narcotics affect most? Name a drug which has both a stimulating and a narcotizing effect.

Tea and Coffee. — The common stimulating drugs we use abundantly are tea and coffee. They contain similar active principles, called *caf'fe-in* in coffee and *thē'in* in tea. The differences in these beverages are due to very small quantities of substances which give the distinctive taste and odor to the drinks. Cocoa contains about the same drug but in such very small quantities that its effect is prac-

tically negligible. The caffein is sometimes extracted from coffee and used, as a white powder or tablet, in medicine to stimulate the heart or brain.

Although caffein is a strong stimulant there is so little of it in a cup of tea or coffee that its effect is usually mild. We differ considerably in our response to it, some people scarcely noticing any stimulation, others feeling it profoundly; many of us are kept awake by a single cup of coffee, taken at night.

In tea leaves there is a puckering substance, *tannin*, such as is used in tanning leather. If the leaves are scalded and the water quickly poured off, the tea is free from this harmful substance. Some tea drinkers tan the lining of the stomach and seriously injure their digestion by drinking tea in which the leaves have been boiled till the tannin is extracted.

It is not the occasional cup of tea at a social party or the coffee at a banquet that does the harm. Although their stimulating effect is readily noticed we have no evidence that it is harmful. It is the habitual use that works the injury. The man or woman who can not start the day comfortably without a cup of coffee, who has a headache when the stimulant is lacking, is bound in the chains of a bad habit. The frequent use of a stimulant so changes the cells of the body, especially the brain cells, that they can not do their work except under such drug stimulus — and even then they do it imperfectly. It is the part of wisdom never to contract the bad habit.

With children the use of a stimulant is worse than a bad habit. Their growing tissues are seriously injured by the drug. Caffein acts on the brain like a whip on a tired horse; it overworks it. Children need the foods that supply energy and the materials for growth, not an excitement to activity. Tea and coffee contain no food, only flavor and stimulant. They should not be given to children.

What stimulating beverages are used at table? What active principles are in these drinks? What harmful effect of coffee is

often noticed? How may tea be prepared so as to avoid one of its harmful effects? What objection is there to the habitual use of coffee at breakfast? At what age are we most injured by tea and coffee?

Narcotics. — The narcotics which have for many years been in most common use are *alcohol* and *tobacco*. There are also several narcotic drugs which have been of great use in the practice of medicine and have been to considerable extent perverted to harmful uses. Among these are *opium*, the dried, milky juice of the poppy, and two of its derivatives, *morphine* and *co′deine* (or *code′ine*). *Co′ca-ine* (commonly called *cocāine′*), another narcotic drug, is obtained from the coca plant. The headache tablets and a number of sleeping powders are called *synthetic* (put together) drugs, for they are made by combining, in such a way as to produce the drug desired, several substances derived from coal tar. *Chloroform* and *ether* are also manufactured substances. They are called *anesthet′ics* (no feeling) because they are used to produce unconsciousness and so render the patient insensible to the pain of an operation.

Name as many narcotics as you can. What are synthetic drugs? What are anesthetics?

The Value of Narcotics. — Before we study the harm resulting from the unwise use of narcotics, let us recognize the value they have when wisely used. When a person is suffering from such pain that he can not rest and seems unable to endure it longer, an opium derivative or some other narcotic brings relief and sleep. The dread of the dentist's chair is largely removed by the use of nitrous oxid gas or a hypodermic injection of *no′vocaine* (a synthetic cocaine-like drug) into the gums. It would hardly be possible to accomplish the wonderful results of modern operative surgery without the use of anesthetics.

Name as many beneficial uses of narcotics as you can.

Outlawed Narcotics. — The opium derivatives and cocaine have proved such a curse to people who have become addicted to their use and such a temptation to thoughtless young people that they have been put under the ban of law. They may not be sold at retail except on a physician's prescription. They get such a grip on those who become addicted to them, and are such subtle poisons that they soon ruin both body and mind. No one, not even he who is enslaved by the drugs, has any defense for their perverted use.

The headache cures, though narcotic drugs, are not poisonous to the same degree as the opium derivatives and have not been outlawed. Yet they undermine the health of those who take them habitually and severely poison when taken in too large quantities.

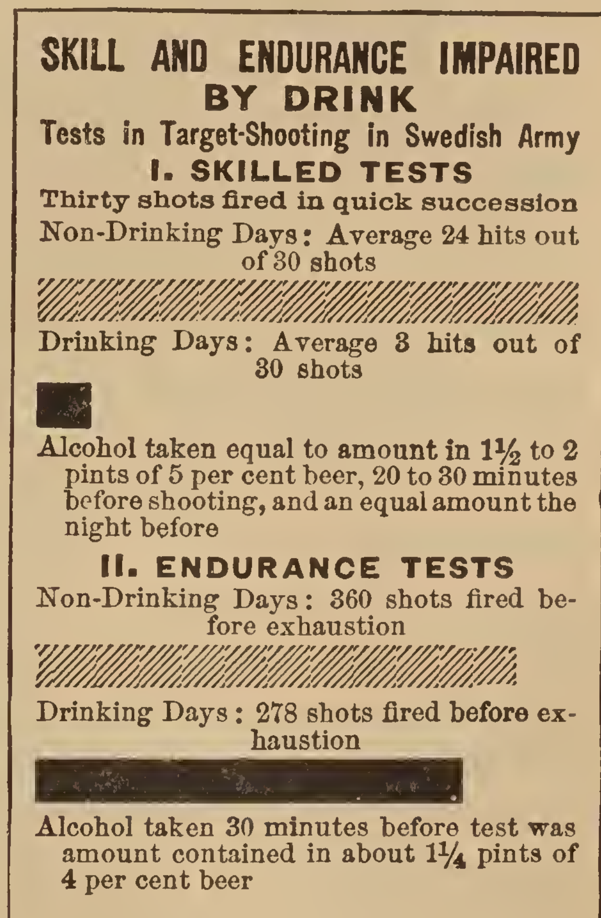


FIGURE 46.

What narcotics other than alcohol are allowed to be sold on prescription of an authorized physician only? How do such drugs affect those who use them habitually? What other useful narcotics result in harm when used too much?

Alcoholic Liquors. — Alcohol, in all the great variety of beverages in which it occurs (wine, beer, cider, ale, whisky, brandy, rum, vodka, sa'ke, etc.), is produced by the growth of yeast in a sugary liquid. The quantity of alcohol varies from two or three per cent up to more than fifty per cent.

The effect of the drink depends more on the quantity of alcohol taken than on the kind of liquor. Since the United

States government has outlawed the traffic in alcoholic liquors for beverage, the friends of alcohol have been pleading for the use of beer and light wine (5 to 15 per cent alcohol), claiming that only the strong liquors (30 to 50 per cent alcohol) are harmful. But a quart of 6 per cent beer contains as much alcohol as a drink of whisky (2 ounces). The free use of wine and beer is followed by the usual train of alcoholic evils.

Since alcohol has been outlawed in the United States it has been extensively produced in home brews and illicit stills. People addicted to the use of alcohol have resorted to all sorts of expedients to get the drink they crave. There have been so many hundreds of deaths and more hundreds of serious injuries from drinking various crude concoctions that everyone should be warned of the danger. *Wood alcohol* has sometimes been put into drinks to give them a "kick." It is a terrible poison, made by a chemical process from wood. It often renders its victims blind if it does not kill them outright. It should never be drunk or used on the skin. *Denatured alcohol* is common grain alcohol into which some substance has been put to render it unfit for drinking. No matter how it is worked over and mixed with other substances it is always a dangerous ingredient of any beverage, but it may be used on the skin.

How is alcohol produced? On what grounds do some people advocate the use of wine and beer while condemning whisky? Why is this difference not justifiable? What particular dangers are encountered in the "home brews" and illicit liquors?

Alcohol's Devastation. — After all the centuries through which wine has held a place of honor it is at last, like a dethroned king, condemned by the discerning and discredited by the common people. Only those whom use has made its devoted adherents still pay homage at its shrine. Alcohol is oxidized in the body and can therefore give us energy, as food can. But it costs ten times as much as good food,

it poisons the nerve centers and deranges the blood circulation, and it ruins the digestive organs when used extensively. It has been thought to stimulate digestion and it does stimulate the digestive glands to greater activity. But it interferes with the action of the digestive juices, so that it hinders more than it helps the digestive process.

A curious thing about alcohol, as well as other narcotic drugs, is that it gives the user a mistaken impression of its effect on him, "wine is a deceiver" in almost every particular. The man who uses it is sure that he is shooting straighter, is lifting more, is computing more accurately, is writing more fluently, after a drink of wine. But the actual test shows that his marksmanship is poorer, his muscular power lower, his mathematical work slower and less accurate when he has been taking alcohol in any form.

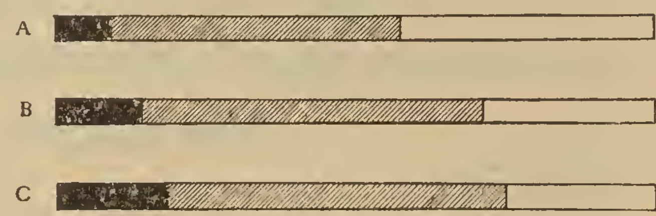


FIGURE 47. — ALCOHOL IMPAIRS SCHOLARSHIP.

The black area represents poor scholarship, the shaded area fair scholarship, and the white area good scholarship.

A. Pupils who never use alcohol. Forty-two per cent have high marks and only nine per cent poor.

B. Pupils who are given wine, beer, or rum once a day.

C. Pupils who are given alcoholic drinks twice a day.

Investigation by E. Bayr, School Director, Vienna.

On the authority of the Scientific Temperance Federation, Boston, Massachusetts.

A little alcohol does render some people very talkative. We all have abundant impulses to speak, but as a rule our judgment sits in control limiting our speech to what seems worth while. Alcohol impairs this judgment, thus taking off the brakes and leaving the speech impulses uncontrolled, and we say in abundance what in our saner moments we would suppress.

Alcohol weakens the body's resistance to disease. Given to children, it stunts their growth and mental development.

Used in excess by parents, it renders the children they produce defective in vigor, weak-minded, and, in extreme cases, idiotic. It is a race destroyer.

If all the good food material which is wasted in the manufacture of alcoholic liquors were given to the starving it would afford them abundant relief. The production of alcoholic liquors impoverishes the world.

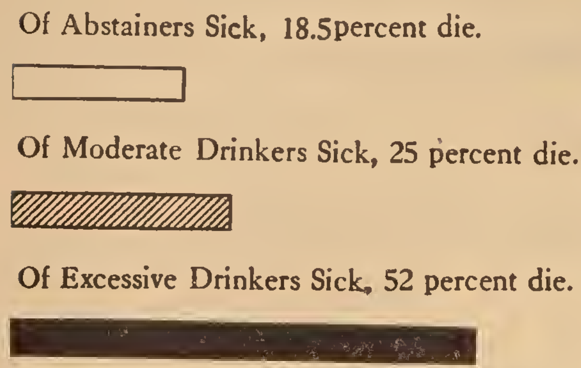


FIGURE 48. — ALCOHOL AND PNEUMONIA.

Drinkers of alcoholic liquors are more likely to have pneumonia than are abstainers and are more likely to die of it.

Osler and McCrea, Nat. Temp. Quar., Dec., 1911. By authority of the Scientific Temperance Federation, Boston, Mass.

What becomes of the alcohol in the liquors that are drunk? Why is alcohol not a good substitute for carbohydrates and fats? How does alcohol affect digestion? Give instances of the way in which alcohol deceives its user. How can a narcotic drug increase any activity? How does alcohol affect children? How does it affect the offspring of parents who use it? Discuss the use of alcohol from an economic standpoint.

Tobacco. — Now that the prohibition laws have restricted the use of alcohol, tobacco remains the prevailing narcotic drug. Few people claim that tobacco does us any good aside from the pleasure derived from its use. Some men think that an after-dinner cigar helps digest the meal, but there is no adequate reason for thinking so. We do not know just how much we pay for the pleasure of smoking a cigar, since comparatively little scientific study has been made of the physiological effects of tobacco, but we do know that the price is enormous. Tobacco produces its agreeable effects of relaxation and comfort by decreasing the activity of the brain, by poisoning the nerve cells.

The active principle of tobacco, *nic'otine*, is a deadly poison. The reason it does not kill outright the people who

use it is that they get very little of the nicotine which the tobacco contains. The body can gradually become accustomed to small quantities of this poison, as it can to many other poisons, but this does not mean that the poison does no harm. The poisoning of the whole body of a child who uses the drug is so great as to interfere with its growth. The heart especially is weakened. The injury to the heart appears in the loss of "wind" when a boy is engaged in an athletic game. The weak heart can not send sufficient oxygen-carrying blood to the brain; therefore the breathing is labored in a vain effort to supply the oxygen. The boy who smokes cigarettes can not get his lesson so well or shoot a basketball so straight as the boy who does not use tobacco.

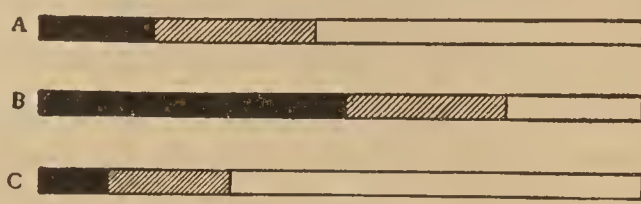


FIGURE 49. — SMOKING HANDICAPS STUDENTS.

Students in Clark College, 1906–1909.

The black area represents habitual smokers, the shaded area occasional smokers, and the white area non-smokers.

A, number of students; *B*, number failing in studies; *C*, number winning honors.

About one fifth of the students were habitual smokers, one fourth occasional smokers, and more than half non-smokers; yet the habitual smokers furnished more than half the failures (students dropped from college or required to take another year), while the non-smokers furnished less than one fourth; about one tenth of the honors were won by habitual smokers, while over two thirds were won by non-smokers.

With permission of the Scientific Temperance Federation, Boston, Massachusetts.

In adults also tobacco slows down the mental activity and decreases the accuracy of the muscular work. The trembling hands of many thousand men owe their weakness to excessive smoking. We strongly suspect, though it has not been proved, that much heart failure in old age is due to the use of tobacco.

In addition to its physiological harm tobacco exacts an enormous financial toll. We pay more for this harmful drug than we do for all our schools. We give our richest

fields to its production. If the land and labor wasted in growing tobacco were devoted to growing food we could feed all the starving of the earth.

Tobacco does not bring its victims to such degradation as do alcohol and morphine; but can you think that the man who puffs his smoke into the faces of his neighbors or into the air they must breathe, usually making them uncomfortable and sometimes making their heads ache, has not lost a considerable degree of courtesy, in gratifying his yearning for the narcotic to which he has become addicted?

How does tobacco produce its agreeable effect? What is nicotine? Indicate the harm it does to children. What harm does it do to adults? How can we realize the enormous financial cost of tobacco?

The Drug Habit. — This phrase is commonly applied to the perverted use of cocaine and of opium and its derivatives, but it is just as fitting to the use of alcoholic liquors, tobacco, tea, and coffee. Any of the stimulants or narcotics used habitually creates an unnatural appetite for itself, a craving which in extreme cases becomes an overmastering passion. An alcoholic drunkard gives up his business, his honor, the things he holds most dear, to satisfy his craving for drink. The morphine or opium fiend overrides every scruple for truth and justice and goes to an extreme of meanness or even crime to get the drug which will gratify his abnormal appetite.

We have no natural appetite for stimulants and narcotics as we have for food and water. If we did not cultivate the desire by repeated use we should never have it. And no one can habitually use any of these drugs without suffering some degree of injury and at times feeling the chains it binds around him. Therefore the sensible thing is never to begin their use.

How is the drug habit acquired? To what extremes may it carry its victim? How can we avoid a drug habit?

Reform and Recovery. — Though it is far easier to avoid forming a drug habit than to break the habit, those who have the misfortune to be the victims of a drug can free themselves from its shackles if they will. We have hospitals and sanatoria for the treatment of the worst cases of alcoholism and morphinism. Even people thoroughly addicted to the use of tobacco and mild narcotics can throw off their chains with the aid of a good physician. Though many people try to reform and fail, there is hope for everyone. The more deeply mired one is in the bad habit the more determinedly he should devote himself to winning his freedom. He should remove himself from temptation and put himself under the direction of a skilled physician, whose orders he should follow implicitly. Few people have so thoroughly ruined themselves that they can not recover a large degree of strength, and most addicts can in time be restored to almost perfect health.

How may a drunkard or morphine fiend avoid the early death toward which he is headed? What means should he take to make sure of reform? Do you think people can be cured against their will? Are any too far gone for recovery?

CHAPTER VI

DIGESTION

Now good digestion wait on appetite
And health on both!

— MACBETH.

When Should We Eat. — We have discussed in a previous chapter *what* we should eat. The next natural question about eating is *when*. We all recognize the need of children's

FIGURE 50. — SCHOOL LUNCH.

The anemic children in some schools are provided with an extra lunch of milk and sandwiches, and are made to lie down and rest an hour in the afternoon.

eating more frequently than grown-ups, — babies, every three hours in daytime. Children five or six years old may well have a lunch in the middle of the forenoon and again in the afternoon in addition to the three meals. For men doing a day's work it is convenient to divide the work-day

into two nearly equal parts with a lunch or dinner during the rest period.

The practice of going without breakfast may be a good thing for some people, but young persons should not adopt it except on a physician's recommendation. Growing boys and girls should have a substantial breakfast without coffee; a lunch or dinner at noon; if they are hungry or underweight, a lunch during an afternoon rest; and dinner or supper in the evening. The often heard objection to eating between meals must be interpreted reasonably. A lunch consisting of a glass of milk and a sandwich between meals is often advisable for growing children. But frequent nibbling, especially of sweets, is objectionable. This commonly gives us more food than we need, and is likely to result in indigestion — fermentation of food in the stomach.

What conditions govern the time of eating? What is the best planning of meals for growing boys and girls? Under what circumstances may it be advisable to eat between meals? What is a "reasonable lunch" between meals? What is the wrong practice of eating between meals, and why?

How We Should Eat; Chewing. — It would seem that such a thing as eating would be done instinctively in a hygienic way. Yet some of us have fallen into unhealthful habits. A peaceful, cheerful state of mind at meal time conduces to good digestion. We should endeavor to lay aside our worries and grouches and make the meal pleasant to others as well as to ourselves. The courtesies and formalities of table etiquette, in so far as they are directed to these ends, are hygienic rules.

The admonition to chew the food well applies to all foods, because the smaller the particles the more rapidly and more thoroughly they digest; but it is particularly valuable with reference to vegetable foods. A chunk of meat in the stomach goes to pieces because the gastric juice dissolves the connecting fibers that hold it together. But the vegetable

cell walls which hold together a piece of vegetable are not affected by the gastric juice. Therefore, a chunk of vegetable swallowed entire goes through the digestive tract as one piece; and the food in the middle of it, not being reached by the juices, is imperfectly digested.

Moreover, the sali'va digests starch, producing a sugar which has an agreeable taste. The more the starchy foods are chewed, therefore, the more they are digested in the mouth, and the better they taste. Digestion in the mouth lessens the work of the intestine, and agreeable taste stimulates the secretion of gastric juices. Thus thorough chewing is an important part of the process of digestion.

When the food has been sufficiently chewed, it is moist enough with saliva to be swallowed easily. To wash down imperfectly chewed food with a drink is unhygienic as well as uncouth. The drinking of water before, during, and after a meal is not only unobjectionable but even advisable, provided it is not employed as an aid to bolting one's food. Persons whose other movements are quick and vigorous are likely to eat rapidly. There is little objection to this so long as the food is chewed thoroughly. To prolong the dinner to an hour or more may have a social value, but it is no more hygienic than to eat it in twenty to thirty minutes.

How does the state of mind affect digestion? What should we do to promote the suitable "atmosphere" at dinner? Why is it advisable to chew any food well? Why is it even more important to chew vegetables thoroughly? On what kind of food does the saliva act? Since starch is tasteless how does chewing it give us a taste sensation? Why is it unhygienic to take a drink while chewing a mouthful of food? Why is a prolonged meal, if it does not result in overeating, likely to be more hygienic than a hasty dinner?

Care of the Teeth. — We can not chew without teeth, and those that nature provides are more efficient than those the dentist makes. Therefore we should do our best to preserve what we have.

Children should be taught to take care of their first set of teeth chiefly because the habit of caring for the teeth will thus be well established by the time it is most needed. Moreover, their mouths will be in more healthy condition, their digestion will be better, and their first teeth will be preserved until the permanent teeth are ready to come. Early loss of the first or milk teeth often results in under-development of the jaw and unsightly and inconvenient crowding of the permanent teeth. The first permanent tooth to appear is the molar, which comes when the child is about six years old. It is often the first permanent tooth to decay and should have especial care.

The care of the teeth is chiefly a matter of keeping them clean. A clean tooth is not likely to decay. The chief places where food remains undisturbed to decay and cause cavities are next to the gums and between the teeth and in the depressions in the crowns of the molars. These places should receive especial attention.

Food particles between the teeth should be removed with a soft pick or, better, with a waxed thread. Silk dental floss is the best thread. Wrap the end of the thread twice around the finger which is placed in the mouth and hold the other end of the thread in the other hand. By a sawing motion force the thread carefully between the teeth and rub it against their surfaces.

The surface of the teeth is best cleaned with a brush, which should be applied to both the tongue side and the lip side and to the tops of the molars. The brush should be moved in a rolling motion from the gums to the teeth. This will avoid pricking the bristles under the gums. The brush should press lightly, especially against the gums and the roof of the mouth. If care is taken not to injure the gums they become somewhat toughened, so that the teeth can be cleaned after every meal without hurting them. It is especially important that the teeth be cleaned before going to bed.

Tooth paste or powder is largely soap and some soft powder like chalk, with a little flavor and disinfectant. Gritty powder like pumice cuts the enamel and should be avoided. A little on the end of a wooden toothpick may be used in smoothing up a rough or stained spot, but if the dentist cleans your teeth once or twice a year you will have no occasion for using a gritty powder.

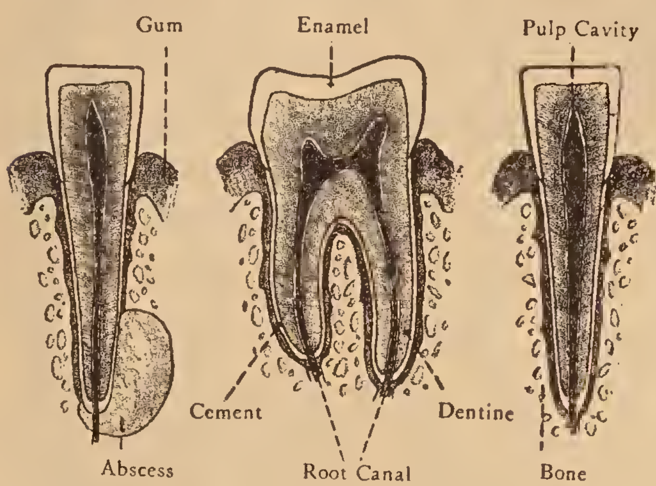


FIGURE 51. — SECTIONS OF TEETH.

The first tooth is an incisor with an abscess on the root, the second is a molar, and the third a healthy incisor.

After the teeth have been brushed there remains on their surfaces, especially between them, a glue-like deposit called *mu'cin*. This enables the bacteria to cling to these surfaces and to start the process of decay. The most harmless and effective way to dissolve the mucin and be rid of it is to rinse the mouth, after brushing, with lime water.

To make the lime water, put a handful of common lime, such as is used in making plaster, into a pint or quart jar and fill the jar with water. As soon as it settles pour off the water in which there will probably be dust or dirt particles, and fill the jar with fresh water. As soon as the lime settles again, the water above it will be clear and ready for use. As fast as the water is used up, add more. The handful of lime will last several months. To use the lime water take a small mouthful and, closing the lips, swish it back and forth between the teeth. Spit it out and rinse the mouth with clean water.

A cavity should be filled as soon as it appears. To this end the teeth should be inspected by a dentist occasionally, every few months if they are weak, less frequently if they

always prove sound. Remember that "a stitch in time saves nine." The discomfort and cost of a small filling are nothing compared with the pain and expense of an extensive repair operation.

There is no danger of your overrating the value of sound teeth. You can not chew well with sensitive teeth. You can not maintain perfect health with decayed teeth in your mouth. Decayed teeth are one of the most common causes of indigestion. An abscess (a mass of pus) at the root of a tooth may not only cause a swollen and aching jaw but may be the "focus of infection" which produces pain in the joints of the arm or leg and much ill health.

Give as many reasons as you can why children should keep their first set of teeth clean. Describe in detail the process of cleaning the teeth. What more should be done to check decay in the teeth? Why should pumice not be used frequently? What evil results come from decayed teeth?

Chewing Gum. — The use of gum as a promoter of digestion and as a tooth preserver has been so widely advertised and is deceiving so many people that it is worth while to set the matter straight. Gum does rub over the more exposed surfaces of the teeth and clean them a little, but it utterly fails to clean close to the gums and between teeth. The places it cleans are constantly rubbed by the lips and tongue and are thus somewhat cleaned without any gum.

Chewing stimulates the flow of saliva; but saliva unmixed with food does no digestive work. The saliva digests starch in the mouth, and in the stomach only before the gastric juice reaches the food. As soon as the gastric juice mixes with saliva, the work of the saliva is stopped. Pints of saliva swallowed after eating digest nothing. This futile production of saliva is a hindrance rather than a help to digestion.

Why is gum practically worthless as a tooth cleaner? Why does not the saliva swallowed in gum chewing digest starch in the stomach?

Stomach Digestion. — After the food is in the stomach we can do little to promote its digestion. Worry and fear retard the secretion of digestive juices. Violent muscular activity may impede the work of the stomach. These unfavorable influences should be avoided at dinner and after. The mind does not work at its best when the stomach is full, because the stomach instead of the brain is getting the large supply of blood. But a little study or light work immediately after dinner does not impair digestion.

FIGURE 52. — PROFESSOR THEOBALD SMITH. (Born 1859.)

He has made extensive studies in animal diseases; has established standards for the inspection of meat; has added much to our understanding of human tuberculosis and early promoted the use of antitoxin.

Bacteria cause most of stomach indigestion. The normal gastric juice contains hydrochloric acid, which kills most of the bacteria in the food and checks the development of the remainder. But if the hydrochloric acid is deficient, the bacteria grow and produce irritating substances which cause the discomfort of indigestion. These irritating substances coming back into the esophagus produce what is called "heartburn." The longer the food stays in the stomach, the more it ferments and the greater is the distress. Therefore quick-digesting foods are recommended to those who suffer with stomach indigestion. A

healthy stomach can take care of foods which digest slowly so there is not the same need of choosing for it foods which digest rapidly.

In addition to choosing foods which remain in the stomach but a short time before they pass on to the intestine, we can do much to relieve indigestion by limiting the quantity of food to the necessary minimum, by using less of the starches and sugars, and by chewing the food thoroughly. Eating in a leisurely manner and chewing thoroughly are the most easily applied and most efficient remedies for indigestion.

Stomach injuries are frequently caused by the excessive use of tobacco, especially chewing tobacco, and alcohol. Except in extreme cases the stomach usually recovers when the use of these narcotics is stopped.

Most stomach ailments are transient and are relieved by a wise choice of food and by hygienic eating. But there are serious diseases which sometimes affect this organ. The worst of these is cancer. If it is neglected it grows gradually worse until it results in death. There is great hope of curing a cancer *if it is taken in time.* Therefore, if one has stomach pains which are not overcome by a careful observance of the rules of hygiene, he should not temporize with patent medicines and quack stomach doctors, but go at once to a competent physician and find out exactly what the trouble is. A sick stomach needs a physician, but a well stomach should be let alone.

The best precept for one in health is: Eat rationally and forget you have a stomach.

What digestion-retarding influences should be avoided at dinner? How may a light lunch promote study and a heavy dinner retard mental work? What is the chief cause of indigestion? What deficiency in the gastric juice results in indigestion? What is "heartburn"? Explain how the method of eating affects the health of the stomach. Why does a drunkard usually have poor digestion? Why should a person having frequent stomach pains

not put off seeking medical advice? What precept should we observe in caring for our stomachs?

Using the table below, make out a list of foods for a person suffering from stomach indigestion. What foods should he avoid?

Food usually begins to move from the stomach into the intestine a few minutes after it is swallowed. The time it stays in the stomach depends partly on its quantity. For instance, the last of 100 grams of meat is sent into the intestine within three or four hours, while twice as much meat would last an hour longer. The following table gives approximately the lengths of time foods have been observed to remain in the stomach.

TIME OF STOMACH DIGESTION

	Hrs.	Min.		Hrs.	Min.
Beef, boiled	2	45	Milk, boiled	2	00
fried	4	00	fresh	1	30
broiled	3	00	Eggs, soft	3	00
Pork steak	3	15	hard	3	30
roasted	5	15	raw	2	00
Mutton, broiled	3	00	Custard, baked	2	45
Veal, broiled	4	00	Fresh bread	3	30
Fowl, boiled or roast	4	00	Sponge cake	2	30
Turkey	2	30	Potatoes, boiled	3	30
Brains, boiled	1	45	Parsnips, boiled	2	30
Liver, broiled	2	00	Cabbage, boiled	4	30
Rice, boiled	1	00	raw	2	00

Intestinal Digestion. — The work of the intestine can be directly influenced even less than that of the stomach, but indirectly we can do much. The digestive fluids which meet the food in the intestine are all alkaline and quickly neutralize the acid gastric juice. This makes the condition of the intestine very suitable for the growth of bacteria. There are always several kinds growing there, producing no harmful results. If we do not rid the intestine of its

undigested residue once or oftener a day, the harmful bacteria may increase to such enormous numbers as to cause illness. The toxins they produce and the nitrogenous wastes which should be carried off in the bowels are then absorbed in sufficient quantity to cause headache and fever.

Certain kinds of germs produce substances which stimulate the muscles in the walls of the intestine to contract vigorously and drive along the contents before the water in the contents has time to be absorbed, and we have a liquid discharge from the bowels as in diarrhea and dysentery. These germs often produce gases also. The abdominal pains of intestinal indigestion are caused largely by the violent contractions of the intestinal muscles.

The intestine is the place where germs of typhoid fever and cholera start their growth. Cooking kills these germs. The bacteria are often brought to the food after it is prepared, on the untidy hands of the cook or by flies. Cholera germs are commonly introduced in the drinking water. Children often get germs into the intestine by putting dirty fingers into the mouth or by taking food with dirty hands.

Several kinds of intestinal worms also (trichina, tape worm, round worm) take advantage of the favorable conditions for growth in the digestive tract and lodge here. The way to avoid all such parasites is to be careful not to introduce the eggs or minute worms in our food. Care and cleanliness with food will prevent most intestinal troubles. The trouble can commonly be relieved by medicines which kill the bacteria or other parasites and stimulate the bowels to expel the offenders.

In our Southern States and the West Indies the *hook worm* infects the intestines of many people and produces an immense amount of sickness and death. The worms when very small enter the body through the skin of the feet or legs. (People who go barefoot often contract the disease.) The worms get into the blood stream and are carried about

until they finally lodge in the lining of the intestine. If nothing is done to expel them, they gradually weaken the victim till in the end death comes to his relief. A little medicinal treatment will nearly always cure a patient who is not too weak. People in the hook-worm region should consult a physician promptly if they are pale and generally "run down." Hook-worm eggs are discharged from the body, and become scattered about the fields, because of the lack of toilet conveniences among the poorer classes. Proper sanitary precautions would check the spread of the hook worm.

Why is the intestine better adapted to the growth of parasites than the stomach? How does injury come from retaining feces several days in the intestine? What causes diarrhea and dysentery? What causes "stomachache"? Name two diseases which start with germs in the intestine. What worms develop in the intestine? How can intestinal parasites be avoided? How can intestinal indigestion commonly be cured? In what part of the country is the hook worm common? How does it enter the body? Where does it lodge and grow? How can its spread be prevented?

Infant Mortality. — Babies suffer worse than other people from intestinal indigestion, because they have not developed resistance to germs and because their food is so liable to contamination. In some localities more than half the babies under one year of age die of this disease. It is often called "summer complaint." It is worse in the summer because the baby's food, milk, is more contaminated with bacteria in warm weather. The food of breast-fed babies is free from the harmful germs and they suffer relatively little from intestinal indigestion though sometimes they get bacteria into their digestive tract by putting all sorts of things into their mouths. Therefore the mother who is able to do so should nurse her baby. She runs a serious risk if she refuses this natural function.

If the baby must be bottle fed the greatest care should be taken that the bottles and nipples be kept clean, scrupu-

lously free from harmful germs, and that the milk be the best possible — certified milk is the best in large cities. If there is any suspicion of the milk it should be boiled. A young mother should be under the careful supervision of a doctor in feeding her baby. A consultation once a month is advisable if the baby is well, more frequently if the baby is not in good condition.

Why do babies suffer more from intestinal indigestion than do grown-ups? Why is summer the worst season? What is the best precaution a mother can take to protect her baby from intestinal indigestion? How can the nursing bottles and nipples be made free from bacteria? What kind of milk should be used? How should it be cared for? Why is it necessary to consult the doctor frequently?

Constipation. — Nearly all of us have occasionally had the feeling of dullness and slight headache that accompany the milder forms of constipation. When this condition becomes chronic (repeated or continuous) it is a serious problem. A doctor can give a dose of medicine which usually sets the patient right in a few hours. But to depend on such medicines (*cathar'tics*) habitually is a bad practice. They are somewhat poisonous and lose their efficiency with repeated use. Neither is "flushing the colon" with an injection of water (called *en'ema*) to be recommended as a daily practice. It does wash out the bowel and bring temporary relief, but it does not tend to restore the bowel to normal activity.

Usually constipation is inexcusable. We could prevent it if we would. It is often owing to lack of exercise, especially the exercise which bends the body so as to move the organs in the abdomen. For those who are unable to exercise vigorously, massage of the abdomen is beneficial.

Often constipation results from the eating of too little coarse food. The muscles of the intestinal wall which contract to move the food along must have sufficient bulk to

act upon. A constant diet of liquid foods, cheeses, concentrated sweets, and such other food as leaves little indigestible substance in the intestine tends toward constipation. Bulk is needed to stimulate the activity of the muscles in the intestinal wall. This bulk is obtained by eating food which contains considerable woody or gristly material. This is another reason why vegetables and whole wheat or bran bread should form a substantial part of our diet. In addition to the digestible elements in these foods, there is an abundance of cellulose which does not digest but furnishes the necessary bulk to promote intestinal activity.

People who drink too little water also suffer from constipation. If the body has too little water, it extracts the water from the intestines, leaving the contents hard and dry. The blood should supply the mucous membrane of the colon with so much water that the membrane will freely produce a secretion to keep its surface lubricated.

Fruit is not a luxury. It is an essential in our diet. Most fruits, especially those containing acids, such as lemons, oranges, grapefruit, and apples have a laxative effect. Prunes, figs, raisins, and grapes are also useful in preventing constipation.

Oil in the food also promotes intestinal action. Only a portion of the fats we eat is absorbed. The remainder is carried away with the refuse, and acts as a lubricant for the intestinal tract. Increasing the amount of fat in one's food, if it can be done without upsetting one's digestion, often helps in overcoming constipation. Some preparations of petroleum are used to this end, often very effectively. They are not cathartics like castor oil, nor foods like olive oil, but merely mechanical lubricants. They are not poisonous, and do not lose their efficiency with repeated use. On the contrary, in stubborn cases of constipation, the regular use of such a lubricant for a time, com-

bined with other means mentioned above, often serves to restore the bowel to normal condition.

What symptoms commonly accompany constipation? Why is the habitual use of cathartics objectionable? To what is chronic constipation sometimes due? What aside from taking medicine can be done to relieve it? Why is a diet of abundant cellulose good to relieve constipation?

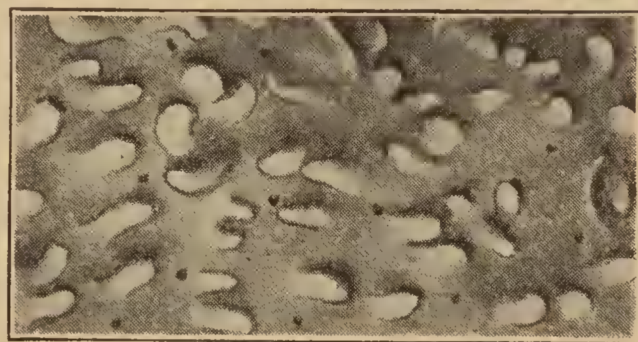


FIGURE 53. — VILLI.

Of the small intestine with a dozen glands, magnified.

Absorption. — The process of getting the digested food from the cavity of the intestine into the blood stream in which it is carried to all parts of the body is called *absorption.* The first step in the process is getting the food through the mucous membrane. This work goes on so slowly that an enormous surface of membrane is necessary. To form such a large surface the membrane instead of being smooth lies in many cross folds, which increases its area considerably. But the chief structures to this end are the *villi*, in the small intestine only, which multiply the surface many fold. The villi are finger-like projections of the mucous membrane, so numerous and so small as to have a general similarity to the coarse nap of plush.

The food is taken in by the mucous membrane — partly by a simple mechanical process of "soaking it up" and partly by the vital activity of the cells — and is passed on to the tubes behind the membrane. The sugar and proteins pass into the capillaries and are carried off at once in the blood stream. The oil (or fat) can not get into the capillaries but is taken up in the *lac'teals.* The lacteals are minute lymphatic tubes. They are so-called from the Latin word *lac*, meaning *milk*, because their contents have a milky

appearance. The oils taken up by the lacteals are passed on into the lymphatic circulation and are poured with the remainder of the lymph into the large vein in the left side of the neck.

The cells of the mucous membrane take up any fluid from the intestinal cavity. Though they absorb some substances more readily than others, they are unable to separate the wholesome from the harmful. Our care, then, is to keep harmful substances out of the intestine by eating only that which is wholesome and by regularly ridding ourselves of the undigested residue.

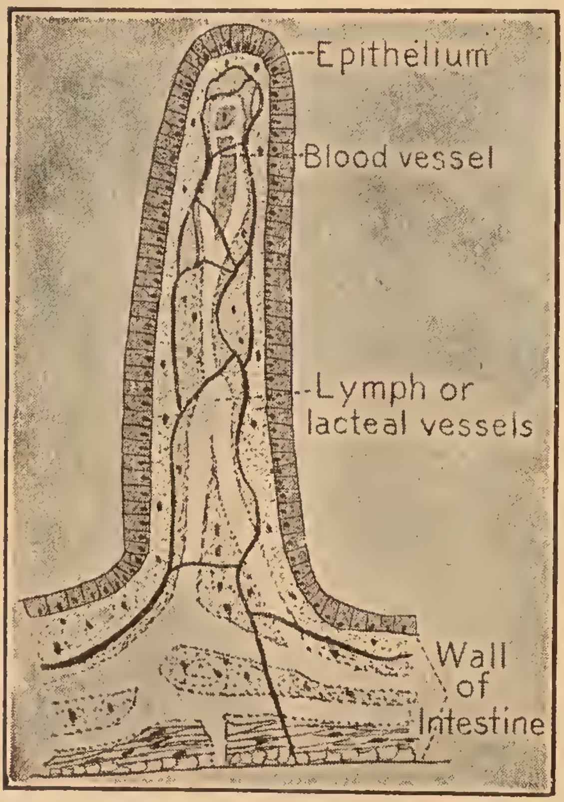


FIGURE 54. — DIAGRAM OF A VILLUS.

The mucous membrane of the small intestine is covered with such villi, whose function is to absorb the food. The blood and the lymph vessels which appear within the villus carry away the food absorbed.

What is absorption? By what means is the surface of the mucous membrane of the small intestine greatly increased? How are the sugars and proteins carried away from the intestine? The fats and oils? Why may absorption by the cells of the mucous membrane lead to trouble? What can we do to prevent such trouble?

Food Storage. — The blood containing the sugar and protein is collected from the capillaries of all the intestine by the *portal vein*, carried to the liver, and distributed through a set of capillaries there. The cells of the liver take out of the blood passing through that organ a large part of the sugar, change it to *gly'cogen* (a substance similar to starch) and store that substance temporarily. When the sugar in the blood has been largely used up by the cells of the body, glycogen is changed back to sugar and passed out to replenish the

blood. Glycogen is also formed and stored in the muscle cells.

Fat is food stored in more permanent form. If we are getting fat, we are eating more food than we need for our current use. A little fat is a good insurance against a temporary food shortage, but much fat is an extra weight to carry around and is nothing short of a nuisance. It is avoided by athletes and is a handicap to anyone who has strenuous physical work to do. Fat can be made in the body from material supplied by food of any class, but it is made chiefly from the carbohydrates. If one is getting too fat, it is advisable to drop sugar from the diet and to eat less of such starchy foods as white breads, cakes, and pastries.

Trace the course of sugar in the body after it is taken up by the capillaries. How does the liver store food? Where else is glycogen stored? In what form more lasting is food stored in the body? Why is it not desirable to be very fat? How can we avoid becoming too fat?

Diabetes. — Diabe′tes is a disease which results from a failure in the sugar-storing process. The pancreas produces, in addition to a digestive fluid, an internal secretion which circulates through the body and stimulates the liver and muscles to store glycogen. Without this internal secretion the glycogen-storing process fails, and large quantities of sugar remain in the blood. When the blood is so overloaded, a considerable quantity of sugar filters out through the kidneys. There is good hope of recovery in the early stages of this disease if the patient faithfully follows the physician's diet regulations, strictly limiting the use of sugars and starches.

This disease sometimes comes from overeating, particularly from overeating sugars and starches. Thin people rarely contract the disease. Fat people should undergo a physical examination occasionally. The disease often " runs

in a family," that is, the susceptibility to it is inherited. If one or two members of a family show the symptoms, the others should be unusually careful of their diet. They can usually avoid the disease by exercising sufficient care.

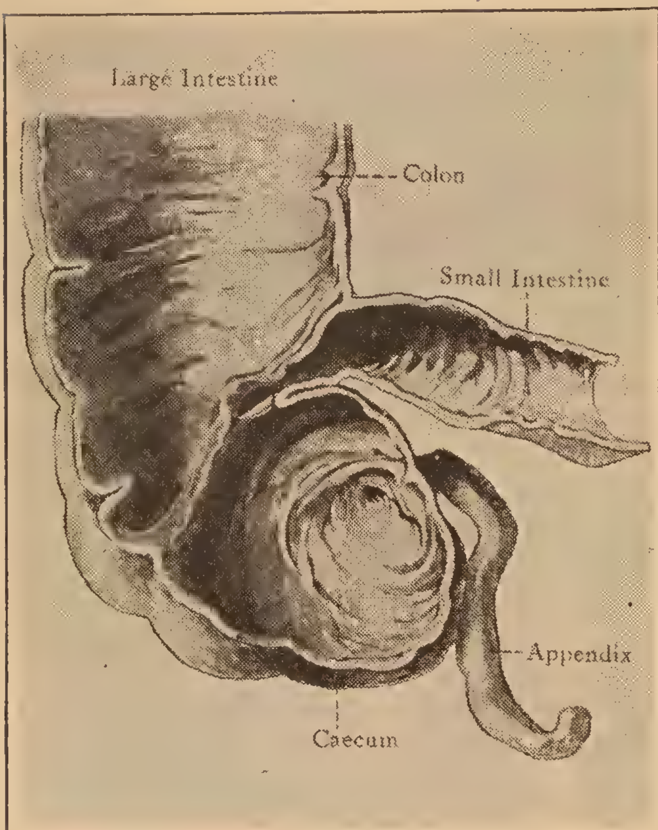


FIGURE 55. — JUNCTION OF SMALL AND LARGE INTESTINES.

1. How does the diameter of the small intestine compare with that of the large intestine, the colon?
2. If food should start to move backward from the colon into the small intestine, how would its movement be affected by the flaps of mucous membrane at the junction?
3. With what part of the large intestine does the appendix join?

What is the cause of diabetes? How may one suffering from diabetes recover? What can one do to avoid the disease?

Appendicitis. — Our primitive ancestors lived on a coarse herbaceous diet and needed a large intestinal space for its digestion. This they possessed in the form of a sack-like appendage to the large intestine near its junction with the small intestine. As time went on they adopted a more and more concentrated diet, and needed less intestinal space for its digestion. Therefore, the large sack-like branch of the intestine gradually shriveled up till it now forms the useless *appendix*.

This degenerate organ is a favorite place for pus-forming bacteria to grow, causing appendicitis. The disease does not come from swallowing grape seeds or any other small solids, but from bacterial growth. We do not know why

the disease attacks the people it does at the times it does, except as they may at those times chance to encounter the germs or be unusually susceptible. We do not know of any means of escaping the attacks except by removing the vulnerable and useless appendix.

The treatment for an acute attack is generally a prompt amputation of the appendix. If the pus is allowed to increase until the sac[1] bursts and the pus scatters through the abdomen recovery is slow, incomplete, or even impossible. Therefore it is important, if one has pain in the lower abdomen accompanied by fever, to have the trouble diagnosed immediately. If it proves to be appendicitis, the doctor will probably operate at once. Early operations are so successful and recovery so quick and easy, that appendicitis is no longer dreaded as it once was.

Explain the degeneration of the appendix. What causes appendicitis? Why do we make no special effort to avoid it? What treatment is advised at the very beginning of the attack?

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[1] A *sack* is a bag or container used for holding articles, such as flour, candy, etc. *Sac* is a term confined to biology and means a small pouchlike organ.

CHAPTER VII

THE BLOOD CIRCULATION

The brain may devise laws for the blood.
— THE MERCHANT OF VENICE.

The Heart. — The pump whose muscle contractions send the blood to every part of the body is an organ which we abuse a great deal and which needs most intelligent care. To understand how to care for it and how to avoid abusing it we must study its structure and action.

The *ven'tricles* of the heart with their thick muscular walls work like a pair of syringe bulbs. The muscular walls of the left ventricle are more than twice as thick as those of the right because the left ventricle pumps the blood all over the body, while the right sends it only to the lungs.

When the walls contract the blood is forced out through the arteries. The *au'ricles* are short-time storage tanks which receive the blood from the veins while the ventricles are contracting and pass it on to the ventricles as soon as the latter relax. The sets of valves are thin, flexible, tough membranes which are moved by the blood stream washing against them. As the blood moves forward it pushes the lobes of the valve to the sides and goes between them. If the blood starts to flow backward it runs behind the edges of the valve and forces the flaps together like folding doors, blocking the opening and completely stopping the backward flow.

What forces the blood out of the heart? What is the function of the auricles? Why are the ventricle walls thicker than the auricle walls? Describe the structure of the valves. What is their function? What makes them open? What makes them close?

Care of the Heart. — Since the walls of the ventricle are muscle they can be strengthened like any other muscle by

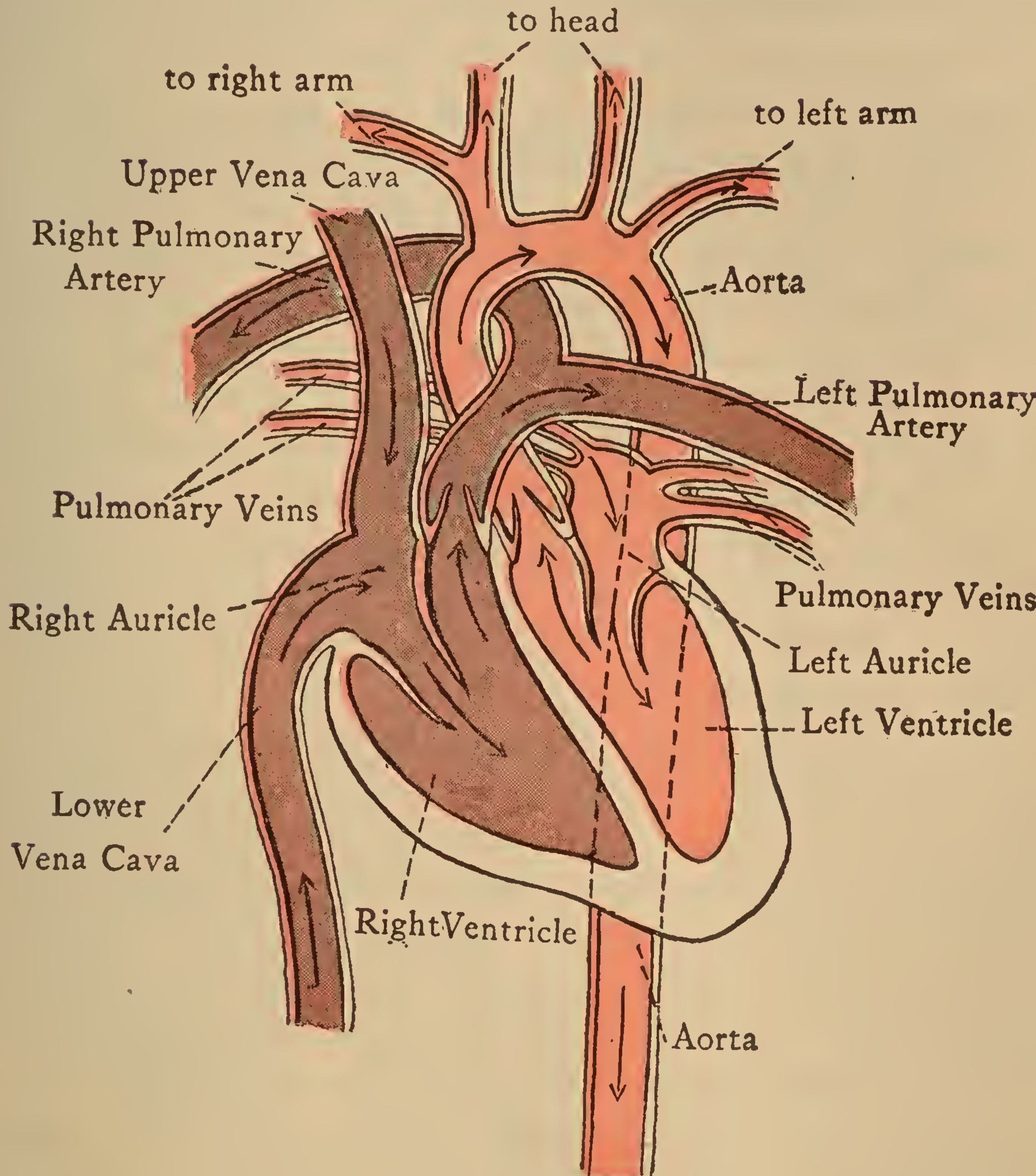


FIGURE 56. — DIAGRAM OF THE HEART.

The scarlet color represents blood just from the lungs, which carries much oxygen and little carbon dioxid. The dark shade represents blood which has just returned from the body where it gave up much of its oxygen and took on carbon dioxid. The valves are the white flaps in the upper parts of the ventricles and at the beginning of the pulmonary artery and the aorta.

exercise, food, and rest. The exercise should be adapted to the strength of the heart, rather gentle at first, increasing in vigor as the strength becomes greater. Athletic

training is largely a matter of strengthening the heart, that it may send a sufficient quantity of blood to the brain and muscles to meet their great demands. Training for "wind" is really training the heart. The need of rest and food is recognized in training. The rule is "early to bed," no stimulants or narcotics, and the most wholesome food.

Under such training the heart grows and increases its strength remarkably. In fact it may become so strong that in emergency it may contract with such force as to strain itself or injure a valve. Athletes' hearts are often injured for life by excessive training and too great exertion, *especially if the training stops suddenly.* Athletes should have their hearts examined frequently and should slow up their pace if the heart shows any signs of being overworked. Football has been discarded in some high schools because some physical directors have thought that it puts too great a strain on the hearts of growing boys.

Most of us do not exercise sufficiently to keep the heart in good condition. When a fifty-yard run to catch a car puts us out of breath and makes us feel faint we should understand that the heart needs training — regular exercise gradually increasing till it becomes vigorous. Of course this applies to a healthy person. If one has a weak heart he should exercise only according to the physician's directions. He may be able to strengthen his weak heart.

All the narcotics are injurious to the heart. The effect of tobacco is so great on young people that the phrase "tobacco heart" has been applied to the symptoms sometimes produced in young men by its use. Excessive use of alcohol produces a profound weakening of the heart; in some cases fibers of muscle waste away and fat forms in their place. Several germ diseases may injure the heart seriously, — an added reason for taking care to avoid them.

How may the muscles in the walls of the heart be strengthened? Why do people get "out of wind" by activity? How are the

hearts of athletes often injured? In what way do most of us fail to take care of our hearts? If one has a weak heart what precaution should he use? How does tobacco affect the heart? How does alcohol in extreme cases injure the heart?

Arteries and Veins. — As the muscles which compose the walls of the ventricles contract with great force, sending the blood under high pressure rushing through the arteries, the arteries must be very strong to resist the blood pressure. Their walls are elastic and give at each impulse of the blood. When you put your finger over an artery in the wrist or neck the pulse you feel is the stretching and tightening of the artery under the increased blood pressure. There is a pulse for every contraction of the ventricle. The blood is forced through the arteries with such a strong impulse that it can not back up.

FIGURE 57. — VALVES IN A VEIN.

They close when the blood starts to move backward.

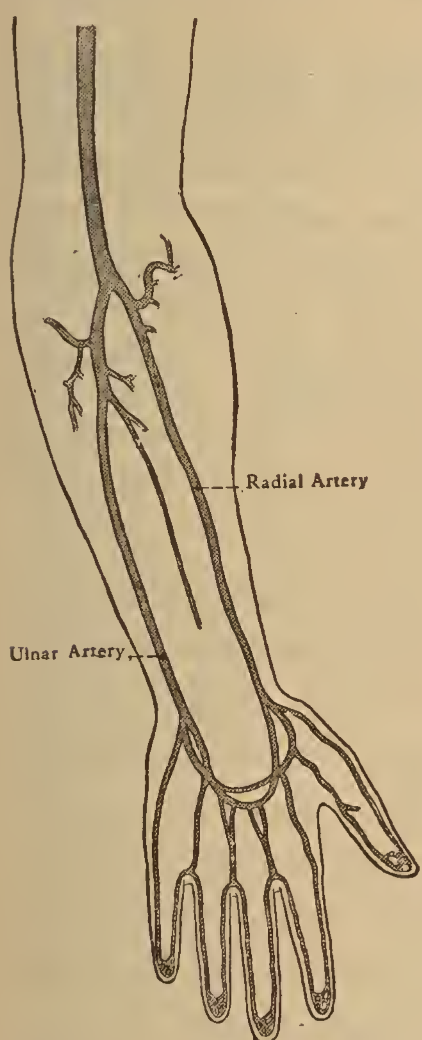


FIGURE 58. — ARTERIES OF THE ARM AND HAND.

1. If the radial artery should be destroyed how would the thumb be supplied with blood?

2. Where else is there a double artery supply?

Its course through the minute capillaries slows it up so greatly that by the time the blood reaches the veins the push of the stream is very gentle. In fact the blood may easily be stopped in a prominent vein by outside pressure. To prevent its being crowded back, there are small membranes, valves, which open in the direction of the blood flow. If the blood starts to back up,

the force of the backward flow flaps these valves across the blood tube and stops the passage temporarily.

Both arteries and veins have cross-connecting tubes to join arteries with other arteries or veins with other veins, so that if one blood tube is obstructed, the blood can flow through the cross-connections to another and so continue on its way.

Why must arteries have very strong, elastic walls? What is the pulse? How many beats of your pulse can you feel in a minute? How many pulse beats in a minute do you feel after vigorous exercise? Does your neighbor's pulse beat just like yours? Press your finger firmly against the skin in many places on your head, neck, arms, and legs, and make a list of the places in which you feel the pulse. Where is the lowest pressure in the whole system of blood tubes? Why do veins have valves and arteries none? If a small artery is cut or obstructed how can the organ normally supplied by it get the blood it needs? Sketch a map of the veins of the back of the hand and indicate the cross-connecting vessels.

Control of the Blood Supply. — When more blood is needed throughout the body for general increased activity it can be supplied by a more rapid beating of the heart. When more blood is needed in one organ only, the vessels leading to that organ enlarge to accommodate a greater blood flow. The muscles by which the diameter of a blood-tube is diminished or increased are kept in tone by the internal adrenal secretion and are under the control of the autonomic nerve centers. Thus the blood supply to any organ is automatically regulated according to its needs.

Alcohol plays havoc with the regulation of the blood supply. Even a glass of wine has such an effect on the autonomic nerve centers as to send an increased blood supply to the skin when it is not needed there: the face is flushed. Men who use alcoholic liquor habitually in large quantity have the skin of the face overcharged with blood so much that the vessels of the nose and cheeks become permanently enlarged, giving the characteristic red nose of the toper.

Exposure to inclement weather also has the effect of calling the blood to the skin, but this is a normal action. The blood is needed to keep the skin warm. In old people the small blood vessels of the skin often become stretched, making the red lines in the face, because the power of adjustment is lost.

The elasticity of the arteries is an exceedingly important property of their walls. They must stretch to let more blood through when more blood is needed. One reason why old people are unable to do the strenuous "stunts" in which young people excel is that their arteries do not stretch to accommodate the larger blood supply required in the greater activity. Our arteries become stiff as we grow old. As long as a man's arteries remain elastic he retains his ability for vigorous activity. Stiff arteries are more likely to break under increased pressure than elastic vessels. A blood vessel breaking in the brain may cause apoplexy, followed often by sudden death.

Alcohol is one of the worst things to take into the body, as it tends to stiffen the arteries. It makes one old before his time. The poisons of certain diseases and those absorbed from constipated bowels also are large factors in stiffening the arteries. If you would live to be "ninety years young" you must let alcohol alone, avoid infections, keep your intestines rid of refuse, and get plenty of fresh air and exercise.

Why does your heart beat more rapidly when you run? By what means is an increased quantity of blood sent to your stomach when food is there to be digested? Explain how the blood vessels can change their diameter. When your hands get cold what is done in your body automatically to warm them? Explain how a drink of alcoholic liquor interferes with the regulation of the blood supply. What people besides users of alcoholic liquors are likely to have red noses?

What ground is there for saying that a man is as old as his arteries? What makes the arteries in many men prematurely old? What danger is there in the hardening of arteries? What can we do to keep our arteries elastic?

The Blood. — The blood is a tissue, composed of cells and fluid intercellular substance. Like other tissues it is subject to injury and disease. A very common affection of the blood is *ane'mia,* a lack of sufficient red cells. When compared with a standard set of shades of red the anemic blood is noticeably paler than normal. One suffering from anemia has pale lips and is weak. The red blood cells are produced from cells in the red bone marrow and some other places. If the blood-producing tissues get too little food or the wrong kinds of food they make an insufficient number of red cells. Iron is the most characteristic element of the red cells, and so medicinal compounds or foods containing iron are given the anemic. Some of the iron-containing foods recommended, as spinach and carrots, are rich in vitamines also. Rest, fresh air, tonics, and adequate diet usually restore the blood to good condition.

What is anemia? What function would the blood be unable to perform adequately in anemia? Consequently how would the disease affect one's power to do work? Where are red blood cells produced? What is the reason they are made in insufficient number at times? What can be done to restore the blood to normal condition?

Mosquitoes and Malaria. — An example of germs that choose the blood for their point of attack is the malaria microbe. Malaria is caused by a small *animal germ* which lives in the red cells of the blood. The germ grows in and feeds upon the red cell until it has destroyed it, and then divides into several germs. Each of these moves into a new red cell and in time destroys it.

The name *malaria,* meaning "bad air," was given to the disease because it was believed that the night air rising from swamps or marshes caused the trouble. It is now known that night air has nothing more to do with the causing of any disease than day air, and that neither "bad air," infected food, nor impure drinking water causes malaria.

The germs are communicated from one person to another only by the bite of the female of a certain kind of mosquito, which flies by night and so made people suspicious of the night air. This kind of mosquito abounds in the tropics but is not abundant in cooler climates. Therefore malaria is a very common disease in many warm and moist regions, but is seldom found in cold countries.

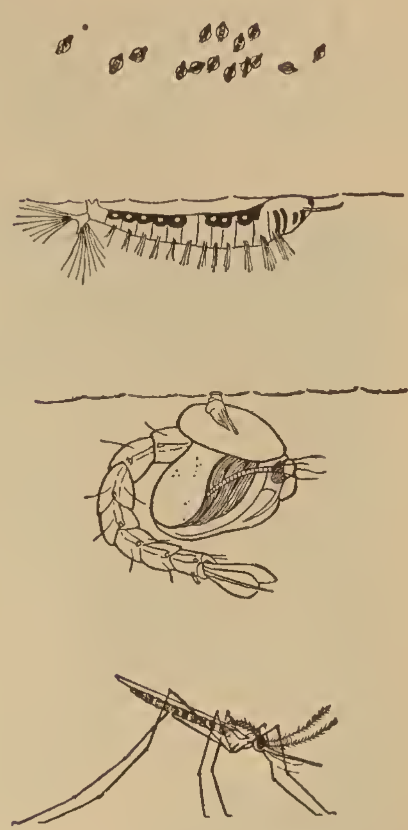


FIGURE 59. — THE MALARIA MOSQUITO.

This figure represents the eggs, larva, pupa, and adult (female) of the mosquito Anopheles which carries malaria germs. The adult is magnified less than the other forms. Note the breathing tubes of the larva and of the pupa at the surface of the water.

Why does oil on the water kill the insect at its immature stages?

The mosquito must first suck the blood of someone who has malaria. A week or two afterward, some of the malaria germs have passed from the mosquito's stomach into her salivary glands. If then she bites a person, she injects the germs down her bill into his skin and infects him with the disease. Malaria is communicated in no other way. If there were no mosquitoes of the sort that convey the disease, malaria could not be communicated from one person to another. If, on the other hand, all persons having the disease were kept carefully screened away from mosquitoes until they were cured, mosquitoes could not become infected and therefore could not carry the disease.

We know then exactly what to do to combat the disease. We must, first, make a concerted effort to exterminate the mosquito, and second, prevent those mosquitoes that survive our war on them from getting and spreading malaria germs.

Mosquito eggs are laid on the surface of stagnant water.

In warm weather these eggs soon hatch out into "wigglers." In a few days the wiggler undergoes certain changes, emerges as a full-grown mosquito, and flies away. After the mosquitoes have taken wing from their breeding places it is too late to make effective war on them. The most far-reaching plan of extermination is to destroy their breeding places. All stagnant pools, puddles, and swampy places should be drained if possible. All tin cans should be buried or punched full of holes instead of being thrown out to collect rainwater for the breeding of mosquitoes.

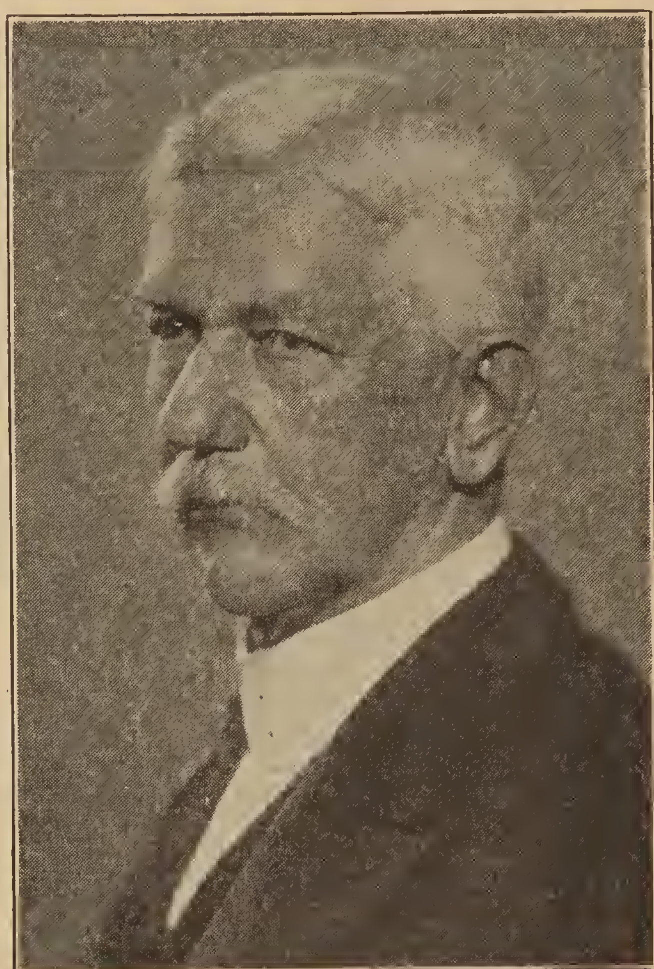
Where drainage is impracticable, other methods have to be employed. Spraying oil over the surface of stagnant water accomplishes the purpose. The wiggler spends most of its time just under the surface of the water, and wiggles down only when disturbed. It can not live more than a minute or two if it is unable to reach the surface to breathe. Oil or kerosene on the water cuts off the air supply from the wigglers. A pint of kerosene or crude oil poured into the catch basin of the sewer about twice a month and as frequent sprinklings of cheap oil on undrained marshes kill all eggs, suffocate the wigglers, and destroy all adult female mosquitoes that try to lay their eggs on the surface.

Water tanks, rain barrels, and cisterns obviously can not be treated with kerosene. Screening such receptacles with 16-mesh screen (16 wires to the inch) is the only solution. Where pools are used for watering of stock, oil can not be used either. In such cases the remedy lies in stocking the ponds with minnows or sunfish, which feed on the wigglers.

The second thing to be done to prevent the spread of malaria is not only to keep all patients so carefully screened that no mosquitoes can get at them, but also to make sure that all malaria patients are cured. Although some cases of malaria are very persistent and defy the most skillful treatment, nearly all cases are quickly cured by a proper use of quinine. The drug should be administered, however,

according to the directions of an experienced physician, since its misuse may seriously injure the body and be quite ineffective in curing the disease.

By the two methods, making war on the mosquitoes and screening malarial patients from the insects until they are cured, malaria has in places (notably in the Panama Canal Zone) been reduced to a point of minor consideration. Individuals can do little to protect themselves. Eradicating the causes of malaria is the work of states, or better still of the Federal Government. It is not too much to hope that it can be driven completely out of our country if we make a concerted and adequate effort. Malaria is such a persistent disease, so widespread in sections where it exists at all, and so destructive of the vitality of the people that it would be economy to spend even several times as much as would really have to be spent to be rid of the malady.



U. & U. photo.

FIGURE 60. — MAJOR-GENERAL WILLIAM C. GORGAS.

He was in charge of the sanitary work at Panama. The successful outcome of his campaign against yellow fever and malaria made possible the construction of the great water way.

Where does the malaria germ live? How does it affect the oxygen-carrying power of the blood? Tell the story of how the germs pass from one person to another. In what two ways should

we combat malaria? Give the life history of the mosquito. In what ways can war be made on mosquitoes?

Why is a malaria campaign a work for the government rather than for a private individual? What drug is a specific cure for malaria? Where has the malaria campaign been wonderfully successful?

Yellow Fever. — The discovery of the fact that the germs of yellow fever are carried by a mosquito and the devising of ways of ridding the country of the disease is one of the wonder tales of science and contains narratives of heroic sacrifice.

In 1898 the United States drove Spain out of Cuba and took charge of that devastated land while it was recovering from the ravages of war and was organizing its own government. One of the great problems was what to do about yellow fever, which had made Havana one of the plague spots of the Western Hemisphere. Dr. Walter Reed, a surgeon of the U. S. Army, was put in charge of a corps of scientists to study the problem.

Doctors had expressed the opinion that the disease was communicated by the bite of a mosquito. By a careful series of experiments in 1900, in which men voluntarily exposed themselves to the disease, the fact was proved that the unknown germ of yellow fever is communicated by a certain kind of mosquito, called *Stegomy'ia*, different from the malarial mosquito. Those who voluntarily slept in the same room with yellow fever patients, but carefully screened away from mosquitoes, did not acquire the disease; while those who were kept carefully away from the yellow fever patients but submitted to the bite of mosquitoes that had previously bitten the patients, were stricken with the disease. One of the heroic commission, Dr. Lazear, lost his life.

When the manner of transmission of the disease was established, the way was clear for a campaign to exterminate

the disease. The sick were gathered into hospitals and kept behind mosquito bars. A campaign of extermination against mosquitoes was carried on and their breeding places were wiped out. In the end Havana became one of the healthiest cities in the Western Hemisphere.

The French had to give up their attempts to construct the Panama Canal in 1899, largely because of the two scourges, malaria and yellow fever. Col. Burau-Varilla, the French engineer in charge of this undertaking, shared the superstition of the time, which was very common in France, that night air is very injurious. It struck him that if the night air could be excluded from the sleeping quarters of the workmen, yellow fever might be checked. Since all of the windows of the Panama houses were simply latticed, he ordered that glass windows be put in all the sleeping quarters and that these be kept tightly closed at night. The number of yellow fever cases decreased after this, and shutting out the night air was believed to have resulted in the improvement. Since we have learned that a night-flying mosquito carries the germs of the disease, we understand how shutting the windows would limit the infection. Mosquito screens would have been better than glass.

A generation ago yellow fever was the terror of our Gulf Coast (the yellow fever mosquito does not come much farther north than Memphis) and of all tropical America. No way was known to stay its ravages. Now it has been nearly wiped out of North America, and persists in only a few localities of South America. What has been done to eradicate this dread disease shows what could be done to rid the country of malaria if the people could be aroused to concerted action.

How was the method discovered by which yellow fever is communicated? What methods of rooting out the disease have been employed? Why did the United States succeed in building the Panama Canal after the French failed? How do we now explain

the decrease of yellow fever among the French in Panama by the shutting out of the night air? To what extent have the Americas been freed from the yellow fever plague?

Blood Fakers. — The blood seems to be a favorite subject for charlatans and superstitious people. If one has pimples on his face or a rash on his skin, if he is weak and listless, the faker's explanation of these and a score of other ills is that his blood is out of order and the "patient" should take some advertised nostrum to restore it. "Blood out of order" is a phrase used to cover up ignorance. It has no clear meaning to those who use it, and brings no understanding to those who hear it. It harmonizes with the misleading advertisements of quack remedies — blood "purifiers," "strengtheners," and "tonics," all offspring of superstition and fraud.

There are definite ailments of the blood which are understood and distinctively named by scientific men. These are treated successfully by skilled physicians, who employ means adapted to the nature of the disease. Only the skilled physician should be trusted to prescribe treatment for such a delicate structure as the body. To trust to a faker or to accept advice of an ignorant gossip is as foolish as it would be to entrust the repairing of a watch to a village blacksmith.

CHAPTER VIII

AIR AND THE BREATHING ORGANS

There are three wicks, you know, to the lamp of a man's life: brain, blood, and breath. Press the brain a little, its light goes out, followed by both the others. Stop the heart a minute, and out go all three of the wicks. Choke the air out of the lungs, and presently the fluid ceases to supply the other centers of flame, and all is soon stagnation, cold, and darkness.

— OLIVER WENDELL HOLMES.

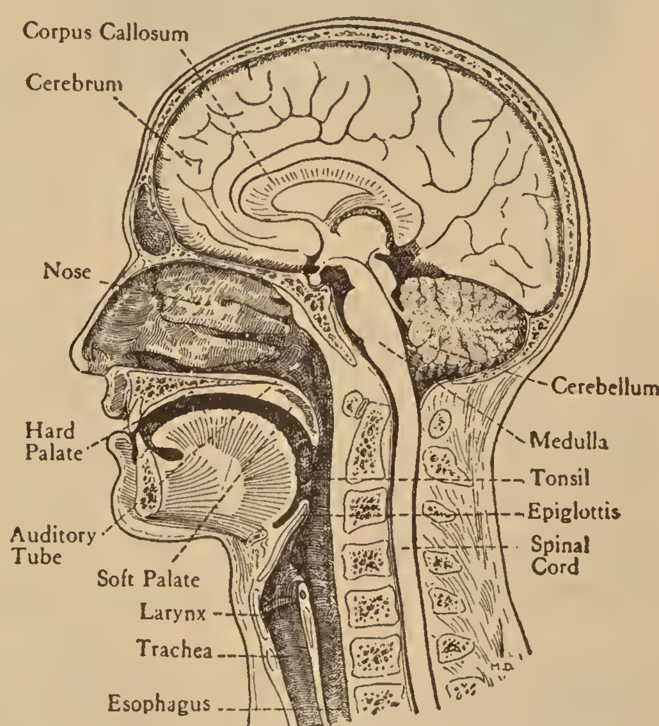


FIGURE 61. — A SECTION OF THE HEAD AND THROAT.

In the larynx may be seen the right vocal cord, the lower margin of the pocket-like slit. The cavity in the bone of the brow is the frontal sinus, which communicates by a little tube with the nose cavity, similar to the sinuses in Figure 63.

Though the process of getting oxygen into the body and carbon dioxid out is comparatively simple, the apparatus for accomplishing it is a vulnerable point of attack for disease germs and therefore requires close study and great care.

Sweeping the Passages Clear. — The mucous membrane which lines the air passages secretes a sticky fluid, *mu'cus*, which, in the case of a cold, bronchitis, or other disease of the respiratory organs, becomes profuse and would stop up the passages. Therefore it must be expelled. Since, unlike the digestive tract, the air passages are closed at the end, the material to be expelled

must be brought to the nose or mouth. To accomplish this the mucous membrane which lines the trachea and bronchial tubes bears on its surface minute threads of protoplasm like the nap on velvet, called *cilia,* which are in constant motion, bending and straightening much like a rapid scratching movement of the fingers.

FIGURE 62. — CILIA.

The mucous membrane cells of the trachea and bronchial tubes bear cilia to sweep the surface of the membrane.

The motion of the cilia drives the mucus in a slow current up the bronchial tubes and trachea to the border of the ciliated surface in the larynx. Here it sometimes accumulates until its quantity is sufficient to stimulate a cough which throws it out. The dust and germs of the air inhaled, striking against the sides of the crooked passage on the way to the air sacs, are caught in the sticky mucus and carried out with it. Thus the air passages are swept free from what in time would accumulate and clog them.

Unfortunately the process is not perfect. Sometimes bacteria get into the mucous membrane and multiply, producing *bronchi'tis.* Or they may be carried by the air current into the air sacs where there are no cilia and where they may cause a great deal of trouble if they are not killed by the white blood cells, or otherwise removed. In the back upper part of the nose also (the naso-pharynx) there is a patch of cilia which sweep the mucus with the dust and germs down into the nose where it can easily be blown out.

Why does the respiratory apparatus need sweeping while the digestive tract does not? What and where are cilia? Describe their movement. What work do they do? For how long after you have been in a dusty atmosphere (sweeping a room) can you notice the black stain in the mucus you cough up?

Nose Breathing. — Breathing through the nose is better than breathing through the mouth for several reasons. The nose passage is more crooked and the walls are folded in from the sides so as to make a large lining surface. This lining is kept moist by an abundant secretion and warm by a rich supply of blood vessels. As the air goes through the nose, the warm moist lining catches a large number of dust particles and germs. It also warms the air and gives up some moisture to it. Thus when air enters the lungs through the nose it is to a great extent freed from impurities; it is so moist that it will not dry up the delicate lining of the air sacs; and it is nearly the temperature of the body.

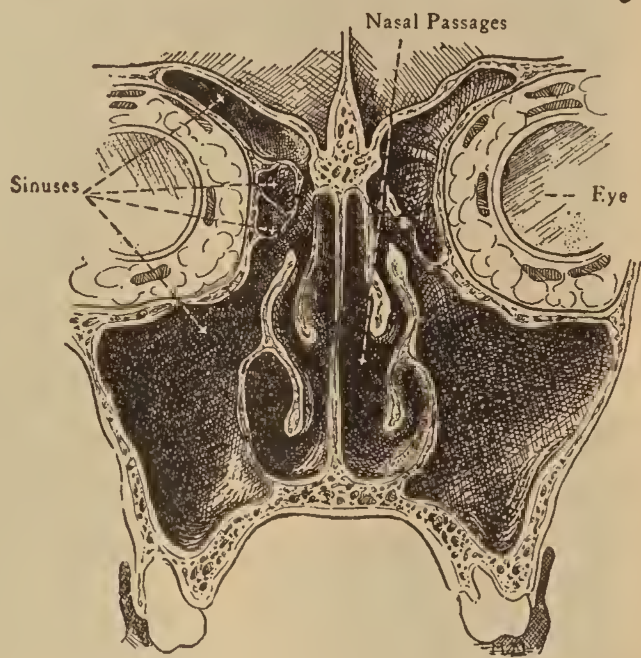


FIGURE 63. — AIR CAVITIES OF THE HEAD.

This is a cross section through the base of the nose and adjoining parts. The sinuses are cavities in the upper jaw and in the bones at the base of the nose.

1. Find the small openings by which the sinuses connect with the nasal passages.

2. What benefit can there be in the side walls projecting as thin strips into the nasal passages?

Some of us breathe through the mouth because we have unwittingly fallen into the bad habit; and we can, if we give the matter attention, establish a habit of nose breathing. Others breathe through the mouth because the nose is stopped up. A common obstruction to natural breathing in children is the growth of *ad'enoids*, masses of soft tissue near the auditory tube. (See Figure 61.) Almost any nasal obstruction can easily be removed by a surgeon and should not be allowed to remain till it has done injury. Although adenoids sometimes seem to make no appreciable

difference in the health, they commonly have a harmful effect quite out of proportion to what one would expect from a simple obstruction to nose breathing.

FIGURE 64. — BEFORE AND AFTER REMOVAL OF ADENOIDS.

The first picture shows a four-year-old boy whose breathing is obstructed by adenoids. The second picture shows the same boy seven months after the adenoids were removed.

Point out the particulars in which the appearance of the boy is improved.

Pupils having adenoids are sometimes below grade in school and seem unable to do their work. They often brighten up to a surprising degree after their adenoids have been removed.

Adenoids and mouth breathing often result in a serious narrowing of the upper jaw, which leaves insufficient room for the teeth, with consequent malformation of these important organs. Sometimes adenoids in little children disappear in a short time without operation, but it is always wise to take a child having adenoids to the doctor, lest the obstruction neglected should result in serious harm.

How is the nose adapted to catch the dust of the inhaled air? How does it affect the temperature, cleanliness, and moisture of the air coming in? Give two reasons why we breathe through the mouth instead of through the nose. What are adenoids? What should one do if he has either of these obstructions to breathing? Discuss the importance of having adenoids removed.

"Taking Cold." — Wet feet and drafts, uncomfortable and sometimes harmful as they are, can not alone produce a cold. A common cold is caused by germs which lodge in the mucous membrane of the nose and throat. The wet feet and draft may detract somewhat from our vigor and so make us more susceptible to the germs, but without the microbes there would be no cold. A current of cold air on the skin chills it, sends the blood back to the interior, and causes a *congestion* of some of the organs there, notably the mucous membrane. The mucous membrane in the nose swells with this increase of blood until it sometimes fills the nasal cavity so as to stop the passage of air. From the increased blood supply an increased quantity of mucus is secreted, in which the bacteria multiply. When this condition is temporary we say we have a "cold." When it becomes chronic we call it *catarrh*.

To prevent a "cold" our chief concern should be pure air. No matter if the air blows in directly from out doors and is colder than we like; it is better for us than the warm air contaminated with the germs from our coughing and sneezing neighbors. When germs get caught on our mucous membrane it is often possible to wash them out before they

have time to get a deep lodgment. To do this fill a drinking glass with water (clear or a little salty), put the nose into it and tip it up gently as if you were going to drink. Let the water run into the nose and out the mouth. It will remove a large number of germs and make an attack of " cold " less likely.

If the germs have already gained a lodgment, vigorous treatment will often remove or kill them and cure the " cold " in short order. Some antiseptic which does not injure the mucous membrane, as *ar'gyrol*, may be introduced with a dropper into the nostrils. A spray should be used under a physician's directions. To relieve the congestion of the mucous membrane a hot bath, and a sweat in a warm bed are advisable. A copious drink of water or hot lemonade and a laxative also are beneficial. To do the most good the treatment should be prompt.

To considerable extent the body can be toned up to resist the germs of a cold. Cool baths, cold sponging of the neck and chest, sleeping out of doors, studying or working in the fresh air are all helpful, but must not be relied on as sure preventives. We must also take pains to avoid the air contaminated by those who are coughing or sneezing with the disease.

What is the cause of a cold? What unhygienic conditions increase our susceptibility to the disease? What is the condition of the mucous membrane when we have a cold? What is catarrh?
Describe two precautions we can take to avoid taking cold.
What can we do to cure a cold?

Tonsils. — The tonsils, a pair of glands situated in the lower part of the pharynx and visible when the mouth is wide open, are not known to do any useful work, but they are the seat of much trouble. They have many little gland pits in which bacteria find lodgment and grow, producing pus and sometimes considerable swelling and great tenderness — *tonsilli'tis* or *quinsy* sore throat.

One of the worst of the sore throat germs is called *streptococ'cus*. It causes fever and severe illness, and often results in complications, such as inflammation of the heart and of joints. Diphtheria commonly starts on the tonsils and spreads more or less over the mucous membrane of the throat. The toxins absorbed from bacteria in the tonsils are carried throughout the body and may result in a general ill feeling, or in acute pains in nerves and joints far from the point of infection, or in serious, sometimes fatal, poisoning of the brain cells. Surgeons recommend the excision of tonsils which are troublesome. This simple operation often cures the patient of a number of ills and renders him less susceptible to " cold," sore throat, or other infections of the respiratory organs.

What are the tonsils? What feature of their structure renders them especially susceptible to bacterial invasion? What is tonsillitis? Germs of what dreaded disease usually start their growth on the tonsils? What extensive effects may come from germs in the tonsils? What can be done to stop tonsil infections?

Si'nuses. — There are several little sac-like branches from the nose and naso-pharynx which are not called to our attention unless they are infected with pus germs. If they do become infected they may cause persistent annoyance or bad headache and (like an abscess on a tooth or germs in the tonsils) extend their baneful effects to the joints of the limbs (arthri'tis). One pair of these cavities lies in the upper jaw bone, another in the bone under the eyebrow. (See Figure 63.) In little cavities in the bone beneath the brain are other sinuses. From the upper pharynx a tube runs to a chamber in each ear. All these cavities are more or less ciliated and so able to sweep out mucus and germs. But they can not perfectly protect themselves. They have small openings through which intruders come with difficulty, but sometimes the germs of a bad " cold " crowd into the sinus and hold possession of the trench, notwithstanding the at-

tack of the white blood cells, until the surgeon opens the cavity and cleans them out.

Give the locations of the sinuses which open out from the nose and naso-pharynx. Explain how these cavities may become troublesome or even seriously impair the health. What means of self-protection have they? What does the surgeon do to remedy the disease? What serious harm can come from a cold?

FIGURE 65. — "HOLD IT SO."

There is a most efficient way of handling a broom. This health brigade of street sweepers is learning from an instructor the best way of doing the work. Street dirt breathed or blown into the eyes is often a source of irritation or worse. To be perfectly sanitary a city must keep its streets clean.

Germs in the Air. — Of the considerable list of diseases whose infection comes by way of the air passages — "cold," tonsillitis, sinus suppuration, influenza or grippe, whooping cough, scarlet fever, measles, diphtheria, tuberculosis, pneumonia, pleurisy, infantile paralysis, and probably a number of others — the germs are sometimes borne in the air and sometimes on the fingers or other objects which enter the

mouth. It behooves us to keep the air as free as possible from the germs of all these diseases. Fortunately the germs of disease do not live long in the air. They are killed by the sunshine. They settle with the dust. So the air, except in the immediate presence of the sick, is free from these microbes.

FIGURE 66. — AIR GOOD TO BREATHE.

This picture represents a scene in the Forest Preserves of Cook County, Chicago's outer belt of parks, a place free from dust and germs where the respiratory organs can function at their best.

The sick do not give off the germs in ordinary exhalations, only in forceful expulsions of the breath, — speaking coughing, sneezing. A cough or a sneeze throws out germs several feet, and the currents in the air soon distribute them through the room. Sweeping stirs up those that have settled on the floor. It is best not to come unnecessarily into the room where there is a sick person contaminating the air with disease germs.

Our individual efforts to keep ourselves away from infectious disease must be supplemented by the government

provisions for sanitation. Hence such ordinances as those against spitting on the floors and sidewalks. People suffering from most of the air-borne diseases can be quarantined. But so many of us have "cold" and tuberculosis, and yet are able to get around and attend to our work, that it is impracticable to quarantine every case. It is the duty of everyone, when he is sick, to limit as much as possible the spread of germs. An open handkerchief held to the mouth and nose during a cough or sneeze intercepts many of the germs. Careless spitting is very reprehensible and may bring most serious consequences. A person having an infection should expectorate into a handkerchief that can be disinfected or into paper or cloth that may be burned.

Name several diseases whose germs enter the body through the air passage. How otherwise than in the air inhaled can they get in? How is the air naturally freed from germs? How do the sick scatter their germs into the air? What can well people do to avoid exposure to the germs? What can the government do to check the spread of infections? What diseases is it practically impossible to quarantine thoroughly? What can those afflicted with colds or tuberculosis do to prevent the spread of infection? Why is spitting on the floor and the sidewalk forbidden? Why is a polished floor with rugs more sanitary than a nailed down carpet? Why should a child with a severe cold stay at home from school?

Other Dangers in the Air.—Dust even if not infected by germs, is harmful to the lungs. When there is much dust in the air some of it is sure to penetrate to the air sacs at the ends of the bronchial tubes. It irritates the membranes and makes them more susceptible to germ attacks. Coal miners' lungs are black with the dust they inhale. This makes them susceptible to tuberculosis and pneumonia. If men grinding tools and cutting stone are not well protected they inhale so much gritty, sharp-angled dust as to result in their early death. The fine lint in cloth mills injures the lungs so that many mill hands have tuberculosis. The fumes of some smelters are so poisonous as to destroy the

vegetation in the neighborhood. They can not be wholesome for the men working or living near.

Factories in which gritty dust comes from the machines, lint from the looms, or poisonous fumes from fires or retorts should have a suction ventilating system in which the air

FIGURE 67. — CONSERVING THE WORKMAN'S HEALTH.

This machine for sandpapering pieces of board would fill the air with dust if it were not for the ventilator tubes which suck up the dust and leave the air fit to breathe.

is drawn from the retort or machine into the flue and never has a chance to get back to the workman. Many states provide by law for such sanitary devices.

Lead compounds are poisonous. Painters, printers, and storage battery makers often are poisoned by getting lead compounds into the mouth. If the dry powder gets into the air, as in scraping off old paint, there is great danger of absorbing so much in the lungs as to cause severe illness.

The pollen dust from flowers is poisonous to some people. When flowers that have a fine, light pollen are abundant in midsummer and early fall there is so much pollen in the air that susceptible people breathing it get hay fever, an irritation of the mucous membrane with profuse secretion which causes sneezing. Such people often spend the critical months in localities where the air is free from the obnoxious pollen.

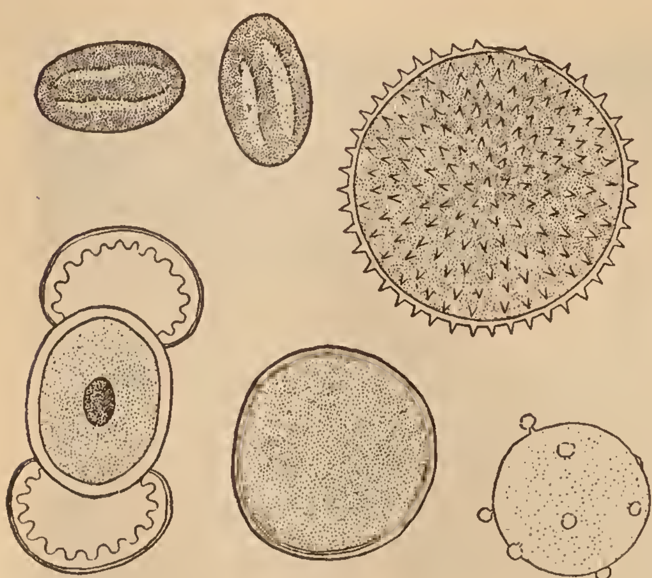


FIGURE 68. — POLLEN GRAINS.

These grains, very much magnified, from several different plants, illustrate what forms the dust which causes hay fever.

Over manufacturing cities there is usually a cloud of dust, smoke from the chimneys and furnaces. All must breathe it in. The cilia sweep it out of the bronchial tubes, the trachea and the nasopharynx continuously, but there is always more to follow. City officials make some effort to keep the air clear for us. They hale into court and fine owners of chimneys which smoke to an unusual degree.

Smoke is unburned fuel. To burn it is good economy. If smoke consumers are installed in furnaces they send the air out of the smokestack fairly clear. But something more radical will be necessary to render the air of cities as pure as it ought to be for our breathing. New York City is kept much cleaner than most cities by its ordinance against the burning of soft coal. In the West the common use of fuel oil makes for cleaner cities. Electrification of railways within the limits of large cities and the use of electric power and water power to run factories and heat homes will eventually make our cities more attractive and sanitary.

In what way does dust injure the lungs? What kinds of dust are especially harmful? What occupations are dangerous to health on account of their dust? How can workers be protected against grit and fumes in the air? What can be done if a manufacturer is disinclined to install safety ventilating devices? What danger do painters encounter in their work? How is hay fever caused? To what sort of place should a sufferer from hay fever go to seek relief? What is the duty of the city government with reference to the atmosphere? What does it do in an imperfect way to fulfill this duty? What policies or devices would be more nearly adequate to the solution of the pure air problem for cities?

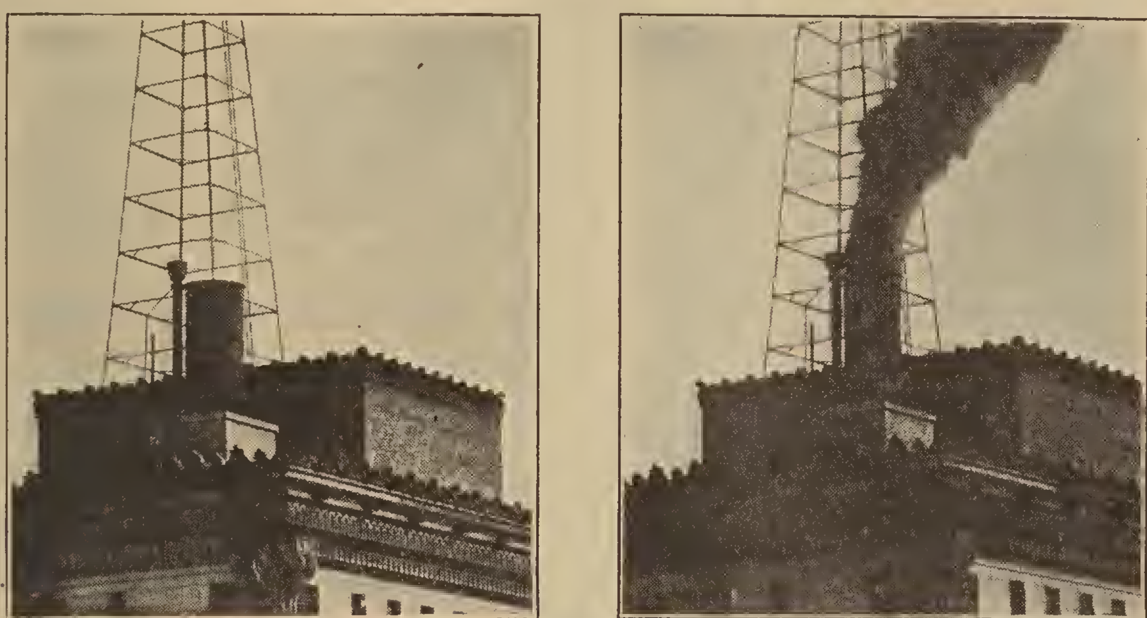


FIGURE 69. — THE SMOKE NUISANCE.

In both these views smoke is coming from the chimney of a tall building. In one the smoke is reduced to a reasonable minimum; in the other the smoke is an intolerable nuisance, a menace to the health of the community, and renders the owner of the building liable to a fine.

Why Ventilate? — We all know that we feel better when we have plenty of pure air than when we are shut up in a close room. We only partly understand the reason. About one fifth (21%) of the air is oxygen. Our red blood cells can carry away from the lungs only their definite load of oxygen. If there is more oxygen in the air than is necessary to load up the red cells the superfluous oxygen does no good. The exhaled air contains about sixteen per cent oxygen. The atmosphere of even a very close room rarely falls to

that figure. For healthy lungs we rarely find an atmosphere deficient in oxygen.

Three or four hundredths of one per cent (.03%) of the air is carbon dioxid. Our exhaled breath contains about four per cent carbon dioxid. If there were many times as much carbon dioxid in the air as there is — even if there were twice as much as in the breath — it would do us no harm. We do not suffer from too much carbon dioxid in the air.

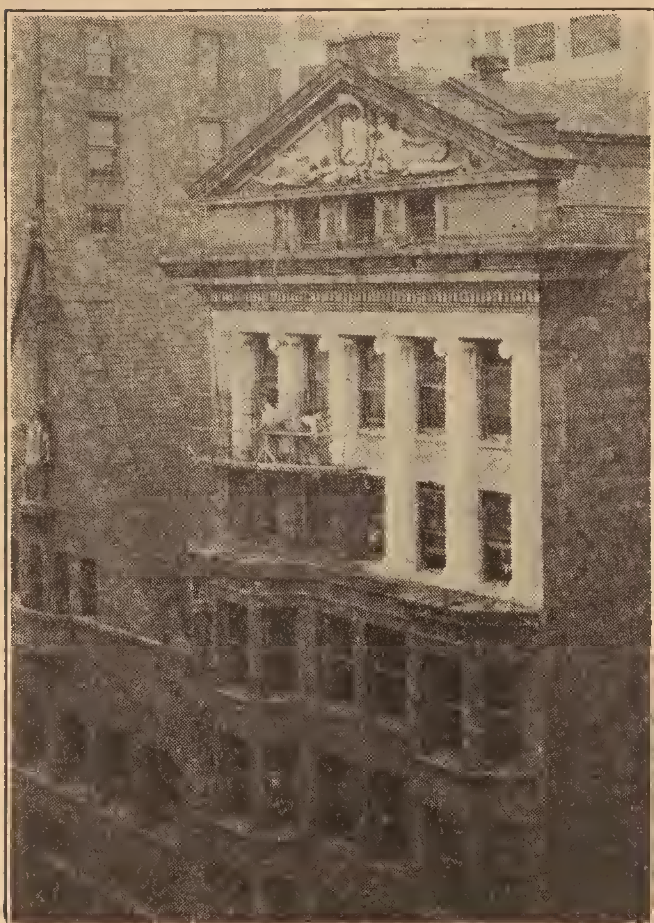


FIGURE 70. — SMOKE-BEGRIMED.

The columns that have been cleaned help us to appreciate how very dirty the city smoke can make a building. Such sooty air is very bad for our lungs.

Why, then, do we feel uncomfortable in a close room? Part of the answer is that the air gets too warm and too moist and the skin does not cool off as it should. But if an electric fan is set going the stale air feels comfortable. One coming into a close room smells the stale air. That is distressing for a while, but the nose soon becomes accustomed to the smell and ceases to register any sensation of it. In winter the house air is so dry from the heat that it is irritating to the mucous membrane of the nose. Close air is more often dusty than fresh air, and especially harmful in the germs it carries. We suspect that there are other reasons why stale air is unsanitary, but we do not know.

What we do know, even though we may not be able to give the exact reasons for it, is that the evil effects of breathing air

over and over again can hardly be exaggerated. The heart slows down, and the body does not eliminate wastes properly. Dullness, feverishness, headaches, sensitiveness to cold follow. In such condition the body offers favorable breeding ground for the germs of "colds," catarrh, tuberculosis, etc.

What fraction of the air is oxygen? What part is carbon dioxid? How many times as much carbon dioxid is in the breath as in the air? What per cent of its oxygen does the air give up to the body? Why would an increase in the per cent of oxygen in the air not help the breathing of a healthy lung? Is the chief aim of ventilation to get oxygen into the room and carbon dioxid out? What changes in the air of a room make it uncomfortable? What in close air does us most harm? What are the practical reasons for ventilating?

How Ventilate? — In summer we are not concerned with ventilation. The windows are wide open and the air blows through. The nearer we can approach this ideal at other seasons the better. Of course in very cold weather we could not warm the large volume of air that would circulate through the room if it were wide open to the outside. Therefore we must have just a little opening that will let in only as much air as we can warm. In a house where there are only a few people the air usually changes sufficiently through the cracks of the doors and windows, especially if the weather is very cold or windy. If a large family crowds into a small room and the cracks are tight a window must be opened, or the air will become very stale. A fireplace is a sufficient ventilator in a living room.

The easiest room to ventilate is the bedroom, because the temperature is permitted to go down. The ideal sleeping place is an open porch the year round, with plenty of bed clothes in the winter so as to keep warm. No benefit comes from getting cold. In the bedroom the window must be open wide even in winter, the bedroom door shut to keep

the house from getting cold, and the sleeper kept comfortable by abundant covering over all but the nose.

Schoolhouses in large cities are usually pretty well ventilated, because provision is made for this in the heating plans. In smaller places, however, there is often no thought given to ventilation in the construction of the building. If the joints are tight, the rooms get very close in cold weather. The windows should always be open, much or little depending on the temperature and the direction of the wind. If the window is down a little at the top and up at the bottom the cold air will rush in below and push the warm air out above. To prevent the incoming cold current from striking the pupils near by, a board or piece of plate glass as long as the width of the window and about a foot wide should rest one edge on the window sill and slant inward, so as to direct the incoming air up over the heads of the pupils.

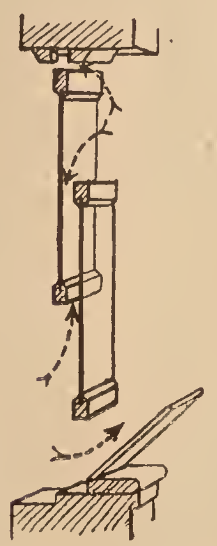


FIGURE 71.—WINDOW OPEN.

What is the use of the slanting board or plate glass on the sill?

Most modern school buildings are heated and ventilated by masses of air which fans drive from the heating coils through large pipes to each room. The foul air is taken out by a pipe from the room to a main ventilator. The heat supply is regulated so as to keep the temperature of the room between sixty-five and seventy degrees. The quantity of air is sufficient to give each pupil a thousand cubic feet, more or less, each hour. The air supply for factories, theaters, and public buildings is regulated by law, that is, only so many people may be admitted as can be provided with sufficient room and air. The number is sometimes regulated according to the square feet of floor space and sometimes by the cubic feet of the room.

What ventilation is ideal? How are homes sometimes ventilated without our thought or attention? How should we open a window to ventilate a room? Why is a bedroom easy to ventilate? What is the best sleeping place?

If the wind is from the west on which side of a schoolroom would you open windows to ventilate in cold weather? Should the windows be open wider in windy, or in still weather? Make a diagram to show the air currents of a room with a window open at top and bottom. How can the incoming cold current be kept from blowing directly on the pupils near? Explain how a modern large school building is heated and ventilated. Is the incoming pipe near the floor, or the ceiling? What is the situation of the outgoing pipe? Why there? Describe the method of ventilating your schoolroom. If you have any good ventilating system in your home describe it. How do our laws protect people in factories and public buildings in their air supply?

Air Moisteners. — One of the most difficult problems connected with the heating and ventilating of houses in very cold weather is that of keeping the air moist. The dryness produced by heating the cold air not only loosens the joints of the furniture but also irritates the mucous membrane of the nose and throat and renders it very susceptible to "colds." Many families suffer all winter from sore throat as they would not do if the air in the home were sufficiently moistened.

The air of a house heated by stoves can easily be moistened by keeping basins of water on the stoves all the time. If the house is heated by a hot air furnace the water pan must be *above* the furnace where the water will be kept hot and evaporate rapidly. A pan at the side of the furnace evaporating a quart or two of water a day is useless.

The air of a steam heated apartment can easily be kept moist by opening a valve in the radiator. There are several appliances on the market which can be attached to the radiator valve to regulate the escape of steam and to render it noiseless. In schoolhouses and other large buildings warmed by air passing over large steam coils, a jet of steam

played into the air just after it passes the heating coils will render the air of the whole building comfortable and healthful.

With hot water heat the problem is more difficult. The various contraptions designed to hang behind the radiator, with wicks from which the water evaporates, are practically worthless. At best they give off no more water than a person exhales in breathing. The wick soon becomes clogged with the minerals contained in the water and ceases to function. To moisten the air of a common house adequately, ten to twenty gallons of water a day must be evaporated. To do this many shallow pans *above* a hot radiator would barely suffice. A fine, mist-like spray thrown in front of an electric fan has been found satisfactory. Any apparatus not having an automatic water feed is likely to be neglected and to prove inadequate.

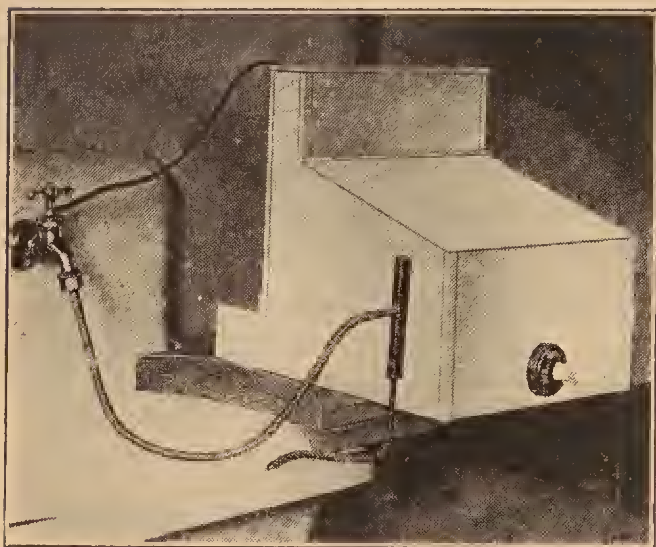


FIGURE 72. — A HUMIDIFIER.

This neat apparatus, driven by an electric current from an ordinary light socket, will add sufficient moisture to the air of a warm house to make it comfortable and healthful even in zero weather. It is made by Dr. P. A. Bryce, Ottawa, Canada.

What harm is done by the very dry air so common in warm houses in winter? How can the air in houses heated by stoves be kept moist? What care should be taken to produce sufficient moisture in a hot air furnace? How can rooms heated by steam be easily moistened? How much water must be evaporated daily to moisten adequately the air of a dwelling house? How can this be done where the rooms are warmed by hot water radiators?

Fresh-air Schools. — During the last few years schools have been established in which anemic and tuberculous

children are kept out doors for their school work the year round. They have a shelter to keep off the rain and snow, but no closed windows, and scarcely any walls. In winter the children are clothed in a fashion somewhat like eskimos to keep them warm. They are perfectly comfortable, and gain greatly in health.

By courtesy of the Elizabeth McCormick Memorial, Chicago.

FIGURE 73. — FRESH-AIR SCHOOL.

The windows of this schoolroom are kept open every day, even in winter. The children enjoy the cold air and study the better under its invigorating influence.

Fresh-air rooms for children in good health have also been tried in many schools. Their temperature in winter usually lies between fifty and sixty degrees, sometimes lower. The windows are kept open even in cold weather. Frames covered with cheesecloth are sometimes put in the windows, through which the air filters gently without a strong draft. Children sitting all day in these cool rooms get accustomed to the temperature and do not feel uncomfortable even

though their clothing is scarcely warmer than that of the children in the warm rooms. The effect of the fresh air is remarkable on both the health and the work of the pupils. They seldom take cold, are rarely out for illness, learn their lessons more easily and enjoy school more.

Live in the fresh air all you can, day and night. Don't be too much afraid of drafts. Moving fresh air is good for you. It is the close, infected air that gives you a cold. Make a hobby of opening windows and don't be ashamed of being a fresh-air fiend. But take the precaution to keep warm and don't annoy others by making them unwilling sharers in your pure air.

For what kind of children were open-air schools first established? How are the children kept comfortable in cold weather? What effects does this treatment have on them? How are fresh-air rooms for children in good health arranged? What is their effect on the pupils? Why should you be a fresh-air fiend?

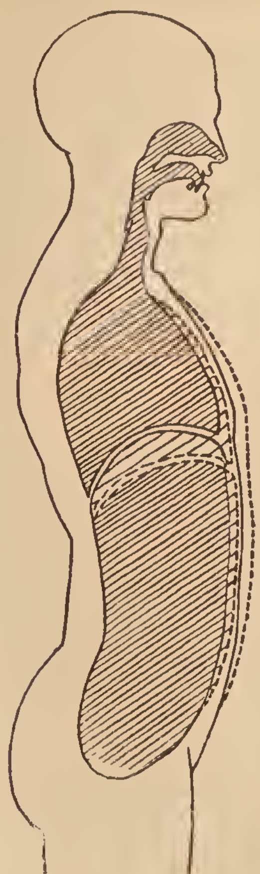


FIGURE 74. — BREATHING MOVEMENTS.

The entire lines represent the position after exhalation, the dotted lines the position after inhalation. The diaphragm, the partition between the chest and the abdomen, moves in which direction in inhalation?

Healthful Breathing. — When we lie asleep we breathe automatically, naturally, perfectly — except when the mouth drops open and we snore. When we are awake we frequently do things to interfere with this perfect breathing. Figure 74 will help us to understand the movements of breathing. Go over it as you read each sentence of the description. In inhalation the chest is made larger that the air may push in. This enlarging is done by the upward and forward movement of the front of the chest

and by the downward movement of the diaphragm. The diaphragm is a sheet of muscle fastened to the body wall around its margin and arching up in the middle. By its own contraction it pulls itself down, pushing out the walls of the abdomen.

To produce exhalation the walls of the abdomen contract, pushing the organs within up against the diaphragm, and arching that organ up into the chest to drive out the air. At the same time the sides and front of the chest spring back and are pulled down to diminish the chest diameter. The part of this apparatus that has the freest play is the diaphragm. Its movement is also best under control; therefore in speaking and singing, in which the breathing must be well controlled, the diaphragmatic movement is most used. Tight clothing around the waist and a cramped position in sitting interfere with this free movement, and force us to use the upper chest walls instead. Some of us get so accustomed in voluntary breathing to using the rib muscles that we are unable properly to employ and control the diaphragm and abdominal muscles — to our great detriment in speaking and singing.

Diaphragmatic breathing is of great value to the blood circulation and to the digestive organs. Every downward movement of the diaphragm compresses the organs in the abdomen, stimulating the intestinal activity and forcing the blood and lymph from the abdominal vessels up into the chest.

When we are under high nervous tension we are inclined to contract the muscles in the throat and chest and take short, shallow breaths. Relaxing this tension helps us to breathe deeply. When we play vigorously, as well as when we lie down, we breathe properly. A good way to break up the bad habit of excessive chest breathing and to learn to use a full diaphragmatic movement at will is to play hard till the breath is full and rapid, then stop and observe your breathing till you get the "feel" of the abdominal move-

ment. As your breathing slows down practice making the movement at will. If you do not at first succeed, exercise vigorously again and study your breathing more carefully. When you get perfectly the feel of the full breath you will be able to reproduce it.

You may also lie on your back and study your normal breathing to get the "feel" of it. The breathing movements are the same but less marked than in the hard breathing after play.

Another good exercise is as follows: Let the pupil stand with his back to the wall, touching it with heels, hips, and shoulders. Let the teacher place his fist firmly against the pit of the stomach of the pupil and require him by contraction of the diaphragm to force the fist back. The pupil must keep hips and shoulders against the wall. The pupil should at first contract his diaphragm while holding his breath, afterward while inhaling. Practice the deep-breathing exercises until you have established the good habit, and if you find yourself falling back into the faulty method of excessive chest movement, resume the practice of exercises till you have the habit more firmly rooted.

Describe the movements of the body which occur in (*a*) inhalation, (*b*) exhalation. Placing your hand on your body, where do you feel the most movement when you inhale? The contraction of what muscle produces this movement? Where do you feel your muscles contract when you forcefully exhale in shouting? (If you feel a grip in your throat in shouting you are using your voice faultily.) Why do speakers and singers use the diaphragm movement more than the rib movement? Name two physical influences which lead us to faulty breathing. What state of mind interferes with good breathing? When do we breathe properly? Describe two exercises which will help us learn to produce the proper breathing movements voluntarily — if we are unable to do so at once. (The teacher should insist that the pupils practice the deep breathing exercises until they have the habit of using the diaphragm properly in speaking.)

CHAPTER IX

THE KIDNEYS

The kidneys are the filters of the blood.

— BACON.

Structure and Action. — The kidneys are bean-shaped organs about as long as the middle finger, that lie in the back of the abdominal cavity, just under the diaphragm — one on each side of the spinal column. They are the filters of the blood. The blood supply comes to them direct from the main artery and returns from them to the large vein that empties into the heart. (See Figure 24.) Within the kidney, the artery divides and subdivides until each minute branch ends in a clump or network of capillaries. These clumps are so tiny that there are approximately a half million of them in each kidney. Each of these clumps of capillaries is in contact with the end of a minute tube. These tubes are so small, so numerous, and so crooked that each kidney contains about fifteen miles of them.

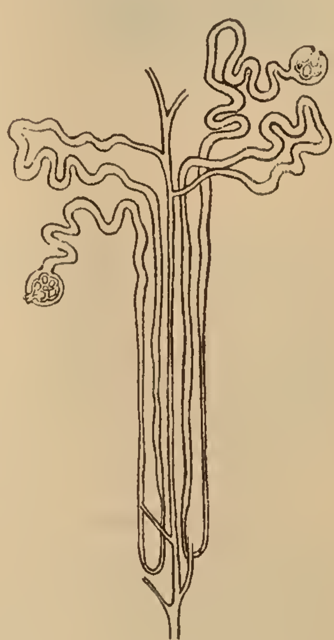


FIGURE 75. — DIAGRAM OF KIDNEY TUBULES.

The wall of each of these kidney-tubes is composed of a single layer of rather thick cells, which act as a filter to the lymph. Their work is not simply mechanical; they are a live filter with power of selection. They hold back in the lymph (to be returned to the blood) the sugar and protein and fat — things needed in the body, but allow water and

certain salts to pass through them. The chief salt thus excreted is *u'rea*, a nitrogenous waste.

The excreted water with all that is dissolved in it travels through the kidney-tubes and empties into a cavity or reservoir in the kidney called the *pelvis*. From the pelvis of each kidney the urine is carried to the bladder through a larger tube called *ure'ter*.

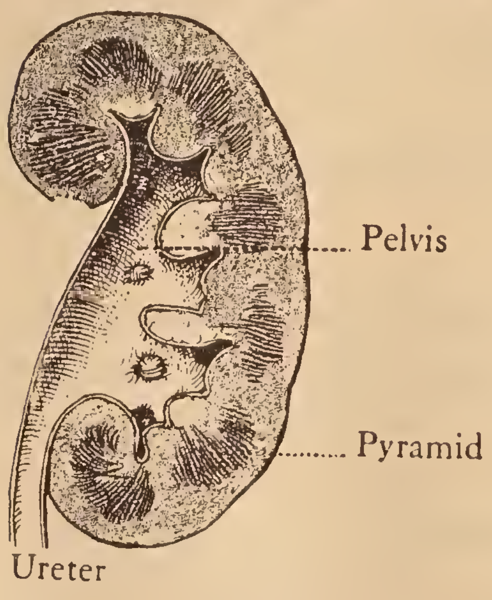


FIGURE 76. — A KIDNEY CUT IN TWO.

The pyramids are composed of the tubules.

The *bladder* is a sac for the temporary storage of urine. Its walls expand as it fills, and contract by means of muscles in them to drive the urine out through the *ure'thra*. At the beginning of the urethra is a ring of muscle which remains contracted to hold the opening shut, but relaxes to allow the bladder to empty. The mucous membrane which lines the bladder and connecting passages is rather thick and does not absorb the wastes extensively.

Describe the general structure of the kidney. How are the waste products filtered out of the blood? What is the chief waste excreted through the kidneys? What do the cells of the kidney-tubes hold back in the lymph? Why should the pelvis of the kidney be called a reservoir? What is the function of the bladder? Describe its structure and workings. By what structure of the mucous membrane which lines the bladder and urinary passage is the rapid absorption of waste prevented?

How Much Water? — The quantity of the excretion from the kidneys depends largely on the blood pressure and the quantity of water in the blood. As in the case of a mechanical filter, the greater the pressure, the faster the fluid runs through. If the blood pressure gets very low the kidneys may fall short in their work and the body suffer from the

accumulation of wastes. In summer when we perspire freely there is less water in the blood for the kidneys to remove. As a result the urine is more concentrated. When we perspire less the kidneys remove more water and the urine is more dilute.

The kidneys can not do their work well when there is too little water in the blood. Most of us should drink more water than we do, that the wastes may be more readily dissolved and filtered out. There is little danger of our drinking too much clear water. Light drinks, brewed, fermented, or carbonated, do tempt many people to drink so much that the kidneys are over-worked in removing the excess of water. Excessive beer drinkers commonly suffer from kidney disease. About three pints of water drunk each day, besides what is in the food, is a fair allowance. In summer we should increase the quantity to allow for perspiration.

Name two influences which increase the rate of kidney excretion. How does a very low blood pressure affect the kidney's work? Why is the urine commonly darker colored in summer than in winter? Why should most of us drink more than we do? What people often drink too much? With what result to the kidneys? About how much water should we drink a day when we are not perspiring freely?

Decrease the Waste. — The less nitrogenous waste there is to be removed, the better it is for the kidneys. Nitrogenous waste comes from two chief sources, the breaking down of protoplasm in the work of the cells and the excessive use of protein as a food. We can not limit the waste from the activity of the cells without limiting our daily activities of work and play. Therefore we must look to our food if we would decrease nitrogenous waste.

We have seen that the cells of the liver take sugar out of the blood, change it to glycogen, and store it temporarily. If we eat much more protein than we need for the growth

and repair of our cells, the excess is also changed — at least in part — to glycogen. But this change of protein to glycogen leaves a waste by-product (urea), which must be excreted by the kidneys.

As has been said, the quantity of protein food needed is estimated by most students of the subject at from one fifth to one eighth of the total consumed. Growing boys and girls need relatively more than adults, since they must have protein both for growth and for repair. But for young and old the greater portion of food should be carbohydrates and fats. Adults whose main diet is protein food three times a day are putting an unnecessary strain on the kidneys that may some day break down the filtering system. When this happens, the cells of the kidney tubes no longer make any distinction between the foods and the waste. Thus nitrogenous poisons are allowed to remain in the blood and albumin escapes through the kidneys. This is called Bright's Disease and is a very serious ailment.

What are the two chief sources of nitrogenous waste in the body? How can we safely cut down the amount of nitrogenous waste? Why is it less of a strain on the kidneys for the liver to store glycogen made from sugar than from protein? Why should a growing boy or girl have relatively more protein than an adult? What serious result may follow an habitual diet of too much protein?

Warning Signals. — Doctors make occasional and sometimes very frequent examinations of patients' urine not only to learn about the state of the kidneys but also to find out what is going on in other parts of the body, for the condition of the urine throws a great deal of light on the body's activities. It often warns of dangers that are not easily detected otherwise. For example, an analysis that shows the presence of sugar in the urine indicates that the sugar storage process of the liver is failing. The kidneys are not adapted to keeping back sugar *in large quantities.* When there is more than about .2 of one per cent in the blood, it

is not the kidney's fault if some of it is lost. The presence of albumin in the urine is a warning that must be heeded immediately, as has been shown above. The kidneys are pretty faithful and able servants, but if we put on them more than they can do, we must blame ourselves and not our kidneys if things go wrong.

What may a physician learn of a patient by an analysis of his urine? Give two examples. How may we reasonably hope to avoid these two ailments?

Germ Infections. — Germs which get into the blood stream, such as tuberculosis, sometimes lodge and grow in the kidneys. Infected kidneys sometimes recover without an operation. Yet it is occasionally necessary to remove a kidney. If one of the kidneys is destroyed, it throws double work on the other. The destruction of both kidneys is fatal.

Not many kinds of germs are likely to work up the urethra to the bladder and thence up the ureter to the kidneys. Some do, however, and it is a serious matter.

Some of the toxins of germ diseases are very hard on the kidneys, rendering them incapable of doing their work well. This is an added reason for keeping ourselves as much as possible from infection and contagion.

By what two avenues may disease germs reach the kidneys? How may certain germ diseases attacking other tissues harm the kidneys?

CHAPTER X

THE SKIN

Bone and Skin, two millers thin,
Would starve us all, or near it.
But be it known to Skin and Bone
That Flesh and Blood can't bear it.

— JOHN BYROM.

Function and Structure. — The three great functions of the skin are protection, sensation, and temperature regulation. For the first of these the skin must be water-tight, germ-proof, and strong enough to resist tearing easily. The strength of the skin lies in the intercellular fibers of which it is chiefly composed. Tear a piece of leather, and you see in the frayed edge the matted fibers; you also get an idea of the strength of the skin, for leather is no stronger than the skin of which it is made.

The water-tight and germ-proof qualities of the skin are due to the *epider'mis.* This is the thin, outer layer of the skin and is composed of cells only. It would tear easily if it did not grow fast to the strong *dermis* underneath. The lower cells of the epidermis multiply continuously and crowd the upper cells away from the supply of food and moisture beneath. The upper, or outer, cells die and wear off, so the epidermis remains of about the same thickness all the time. The dead epidermal cells form the somewhat waxy, dry, hard surface of the skin, which is nearly water-proof and almost germ-proof.

Pressure on the skin stimulates the epidermal cells to rapid growth, producing the hard, thick spots of callouses and corns.

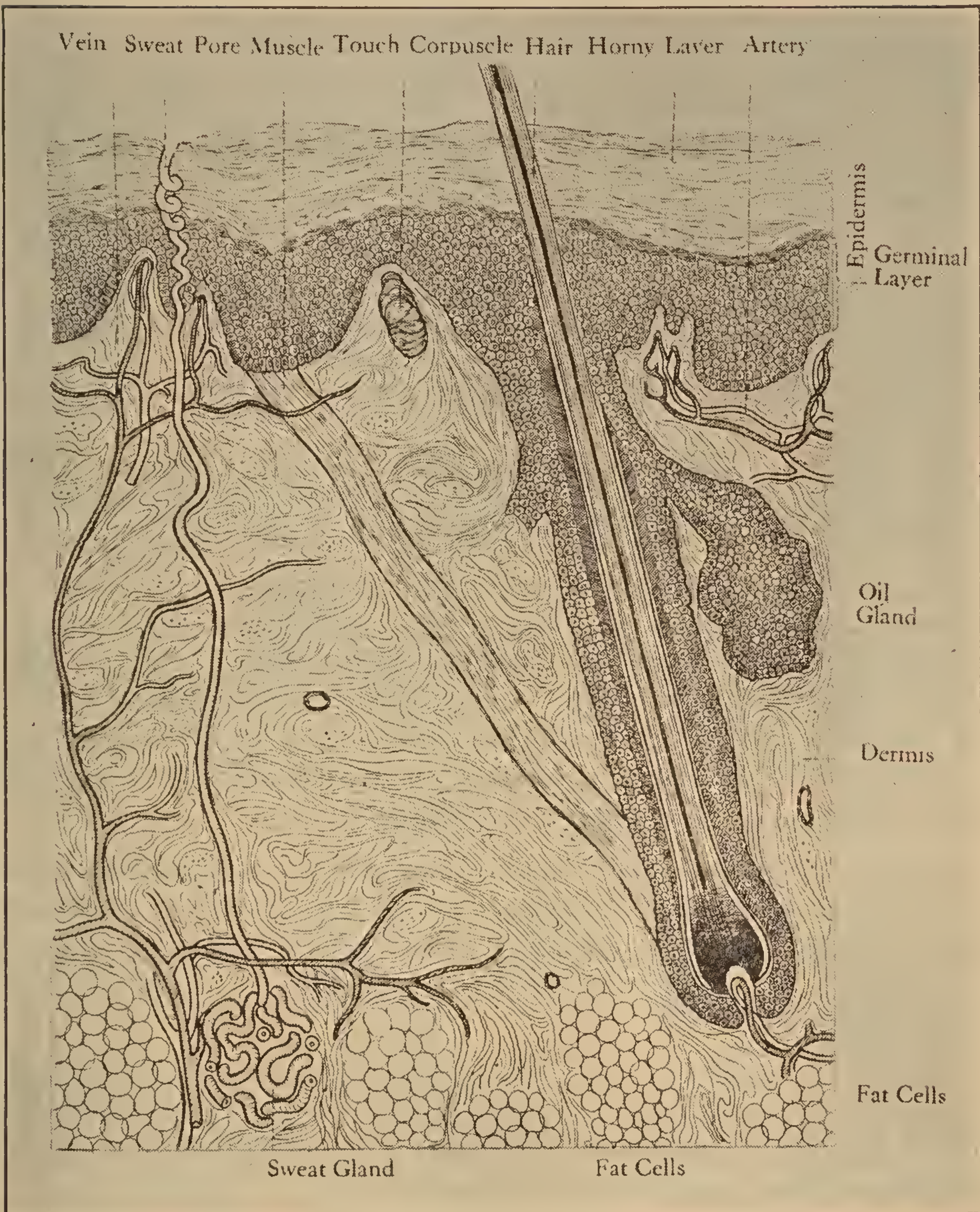


FIGURE 77. — DIAGRAMMATIC CROSS SECTION OF THE SKIN.

1. Which is thicker, the dermis or the epidermis ?
2. Which part is composed of cells only ?
3. Which part is chiefly composed of fibers ?
4. In which part are blood vessels ?
5. Where is the fat ?
6. What is the situation of the oil gland ?
7. What means is there for making the hair stand erect ?
8. Describe the sweat gland.

We recognize three sense organs in the skin — those of touch, of heat, and of cold. These are formed by nerves which end in some of the lower cells of the epidermis and in peculiar little *papil'lae*, minute finger-like projections, which extend from the dermis into the epidermis. Some of these nerves, when their tips are stimulated from the outside, carry to the brain currents which give the sensation of touch. Others give the sensation of warmth, and still others that of cold. Where nerve endings are closer together, the sense of touch is more acute.

The temperature regulation of the body is almost entirely accomplished by the skin, as explained on page 32.

What are the three chief functions of the skin? What are the three chief qualities by virtue of which the skin is a good organ of protection? Why need the skin be water-tight? What detail of structure renders the skin water-tight and germ-proof? What are the little rolls you rub off your skin after a warm bath? How is a callous produced? Of what is a corn composed? To what does the skin owe its mechanical strength?

Name the sense organs situated in the skin. Just where do the nerves of sensation end in the skin? What difference makes the fingers better able to distinguish small things than the back of the hand? What parts of the body should you infer have few nerve endings?

Review in detail the story of how the temperature of the body is regulated. How is heat produced in the body? How is it given off? How is the rate of losing made to equal exactly the rate of production?

Infections of the Skin. — Though the skin is fairly germ-proof, infections of it and through it occur in several ways. Accidental punctures and scratches and scrapes, large or small, introduce germs. A needle prick may carry in germs of blood poisoning, which result in serious illness and sometimes in death. The explosion of a paper cap in a toy pistol may drive in the germs of tetanus and produce death. Though such terrible germs as these do not frequently at-

tack us, it is of great importance that we keep the epidermis unbroken. Biting insects of many kinds force disease germs into the skin — either disease germs already lying on the skin or germs which they bring from other people.

The germs lying on the skin and forced in by the bite commonly produce no more serious harm than a little pustule. Severe diseases whose germs are brought from sick people and bitten into the skin by insects in this country are yellow fever and malaria caused by mosquitoes (see pages 118–122), mountain fever caused by ticks, the bubonic plague caused by fleas, typhus and trench fever caused by body lice.

Some germs are able to work down the hair follicles and oil glands and produce pustules and boils. Common pimples (*ac′ne*) are so formed. Even when we are free from acne, germs may still get into our oil glands. But probably the germs which get in are killed by our white blood cells. Acne comes probably when our white cells fail to kill the germs. Indigestion is often accompanied by pimples. The treatment of severe cases of acne should be entrusted to a physician.

We can all do something to keep the skin free from pustules by maintaining a good condition of the stomach and by keeping the skin clean. Pustules should be pricked open with a septically clean needle, the pus squeezed gently out and wiped off, and the skin sponged with alcohol or other antiseptic.

Boils and carbuncles are deeper seated pustules, of more poisonous germs. The germs are sometimes forced into the skin by scratching with the finger nails. Don't scratch your skin. A stiff collar may rub in the germs to cause carbuncles in the neck. Carbuncles should be opened, the pus let out, and the skin around them sponged with an antiseptic. A hot compress will keep the surface soft and thus somewhat relieve the pain, reduce the swelling, and help to expel the pus. The old-fashioned poultices are objectionable in that they harbor germs. They accomplish noth-

ing but to keep the surface moist. A hot antiseptic compress is better.

The pustules of smallpox and chicken pox are made by germs brought to the skin in the blood. Some germs, *e. g.* ringworm, live on the surface of the skin and in the hair follicles and in the hairs themselves. A single treatment with iodin will kill the germs on the surface. If they get into the hair, it may take months of treatment to get rid of them. Itch is caused by a tiny mite which burrows in the skin. It is killed by an ointment. Ringworm and itch are contagious. Children having them should keep away from others.

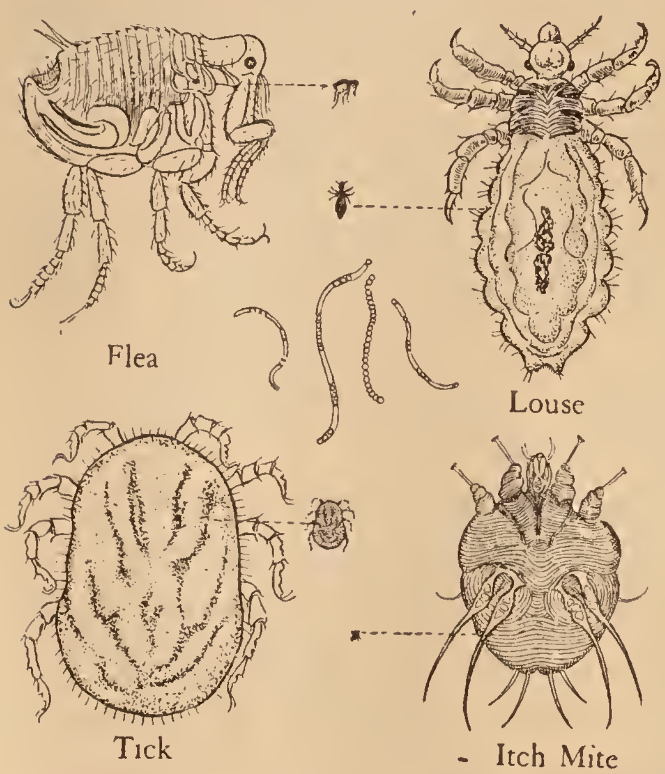


FIGURE 78. — PARASITES WHICH INFEST THE HUMAN SKIN.

The small sketches are natural size. The flea carries the germs of bubonic plague. The louse is the "cootie" of war-time fame. It conveys the germs of typhus fever. The tick carries the germs which cause Rocky Mountain spotted fever. The itch mite burrows in the skin and so causes the itch disease. In the middle of the figure are four mold-like threads, more or less broken up into spores, which grow in the skin and hair causing the ringworm — not a worm at all but a plant parasite.

What very dangerous germs get into the skin through very small pricks? Why should we as soon as possible put iodin on scratches, scrapes, and punctures of the skin? How can biting insects produce pustules? Name several severe diseases communicated by biting insects, and the insect which brings each. What produces pimples? What condition of the body is conducive to acne? What care should we give the pimple? What can we do to prevent acne? Describe the method of taking care of a boil or carbuncle. Why are poultices

objectionable? What is better than a poultice? What germs brought by the blood produce pustules in the skin? What is ringworm? How is it cured? What is itch? How cured? How prevented?

Clothing. — We adapt our clothing pretty well to the use it is to serve, except when vanity overrides judgment — a thing far too common. We have strong clothing to protect us from scratches and bruises when we work, warm clothing for winter, light-weight clothing for summer. However, there are some particulars in which we are quite irrational in our use of clothing. We must try to bring all our practices into harmony with the needs of the body. The chief physiological function of clothing is to keep the skin at a temperature nearly uniform. A regard for our own comfort prompts us to adapt our clothing to this end, but convention often interferes. Men's coats are ridiculously warm in summer, while women's light garments are quite sensible. In cold weather, however, men are more sensibly dressed, and women, though they may not admit the fact, suffer from exposed chests and thinly clad feet and legs. If it were a matter of comfort only, we could pass it by in silence, but it is a matter of health and should have our careful attention.

Some people have a theory that we should make ourselves hardy by constant exposure to inclement weather. There is considerable truth in this theory, and it is a natural recoil from the common practice of wearing clothing too heavy. Fresh air, even on bitter cold days, is a good thing, and we should train ourselves to be able to enjoy it for a little while. But there is no good to be had from suffering from the cold. It is better for us to go out warmly dressed. Yet if we are too warmly dressed, so that the skin is moist and soft, there is danger of its becoming chilled and the blood driven out and congested in the mucous membrane with a resulting cold or worse. We should aim at a medium course.

Clothing which does not permit a good ventilation of the skin or is tight is objectionable. Our feet suffer most from poor ventilation, as their moist, unhealthy skin attests. Low shoes are not so bad as high; sandals would be better than either. Garters around the leg constrict the veins and interfere seriously with the circulation. There are defenders of the low, comparatively loose corset, though it is poorly ventilated and interferes with the blood circulation of the skin; but there is only condemnation for the tight garment which not only injures the skin, but deranges the whole blood circulation and breathing process and crowds the organs of the abdomen and pelvis out of place, frequently with tragic results.

The material of which our clothing is made is not so important. Wool can not be woven into cloth so thin as cotton, linen, and silk. Therefore it is better adapted to winter. Its spongy texture enables it to hold more air (a nonconductor of heat), and so it better protects the skin against sudden changes of temperature. It is more comfortable than cotton when a garment is wet. On the other hand it is more difficult to wash than cotton — and it is important that clothes be kept clean.

Think of as many ways as you can in which our clothing is adapted to its uses. What is the main value of clothing as a health factor? Give as many illustrations as you can of the way in which convention restricts our reason and comfort in the matter of clothes. What virtue is there in the notion that we should toughen ourselves to endure inclement weather? Is it better for us to dress warm when we go out in the cold, or to school ourselves to endure the discomfort? Why is it not advisable to wear a heavy woolen "tippet" around the neck? Why are the chamois "chest protectors" not advisable for most of us?

What objection is there to wearing a rain coat a great deal? How do rubber boots injure the feet when worn too much? In what way are low shoes better than high? What benefit can come from going barefoot? Why are garters objectionable? What

is better for a girl to wear than a corset? Explain how the old-style tight corset injured its wearer.

Explain how wool is better adapted to winter wear than are other common cloths. Why does the nurse use flannel for the young baby's binder or shirt? Think of several reasons why work clothes are made of cotton.

Bathing. — The chief aim of the bath is cleanliness. There is little danger that any of us will be too clean or bathe too often. Two or three short baths a day would do us no harm, but are not necessary for reasonable cleanliness. Soil and soot on the skin are not a menace to health, but the germs of pus and disease are. Some of these are usually present. A scrub removes most of them. The social value of cleanliness is as great as the health value. The dead cells and the oil and sweat on the skin do us no harm, but do become offensive if not washed off. A bath each day keeps us clean. Once or twice a week does fairly well. Soap should not be used too freely. A scrub with soap and hot water once a week is often enough, especially in winter when the cool skin secretes less.

The cold bath in the morning is of great value to many people, but must not be recommended to all. It is a stimulus to our sluggish activities. Try it for a few weeks. If you feel warm and more like working after it, make it your habit. If it leaves you cold and half dreading to repeat it, try a warm sponge or a dry rub instead. Don't think it your duty to take a cold bath, and don't feel virtuous because it is your practice. It is a good tonic for those who react well to it, but weakens those who do not. The cold bath should last only a minute or two, and its temperature should be adapted to the vigor of the bather. A hot bath in the evening will often relieve nervous tension and bring reluctant sleep.

Therapeutic baths are of great value in treating some diseases, but they should be used under the direction of a physician.

What is the main purpose of bathing? How does bathing promote health? Explain the social value of bathing. Why is a hot water and soap scrub advisable once a week but not daily? In what way does the cold bath in the morning do us good? How can you tell whether it would be good for you? If you find the cold bath objectionable, what might you try instead? How long should you stay in a cold bath? If you are wakeful after an evening of study what can you do to get the blood from the brain to the skin? What are therapeutic baths? Why should we be suspicious of the advertisements of those who claim to work wonderful cures by the baths they give?

Cosmetics. — Powder and paint are relics of barbarism. The reds and pinks and whites and blacks we use are no more beautiful than the greens and browns and whites and blacks of savages. We can not condemn them too strongly from an esthetic standpoint. But we should tell the truth about them. They do not poison the skin and fill up the pores. They are sometimes substituted for washing — which is a pity. The most beautiful complexion derives its beauty from within. We should aim to have a healthy skin. That means a clean skin, good digestion and a vigorous blood circulation, — general good health.

Cold creams help keep the skin soft, especially after soap has washed off the natural oil. But we should not be taken in by the hoax of "feeding the skin" with any cosmetic. The skin food comes from the blood. Many hand lotions are good for chapped skin, though the advertisers are likely to overstate their value.

What sound objection is there to powder and paint on the skin? How is a beautiful complexion to be obtained? Do you know of any evidence that the skin can be "fed" from the outside? For what is cold cream good? What are hand lotions good for?

Hair. — Hair has a protective use, as those of us who have little know on a cold day. But it is worth preserving for its esthetic value as well. Hair grows by the addition to its root of particles from the epidermis. The hair itself has no life. If the epidermis of the scalp is healthy the hair

grows better. The best we can do to preserve it is to take care of the skin. We should keep the scalp clean, free from germs. Rubbing is good to stimulate the blood supply. Hair is sometimes clipped to make it grow thicker. There is no reason to suppose the cutting has any such effect. Hair is often injured by a curling iron too hot. Fortunately the roots are unharmed and the new growth will in time repair the injury. We are advised not to wet the hair frequently in combing it.

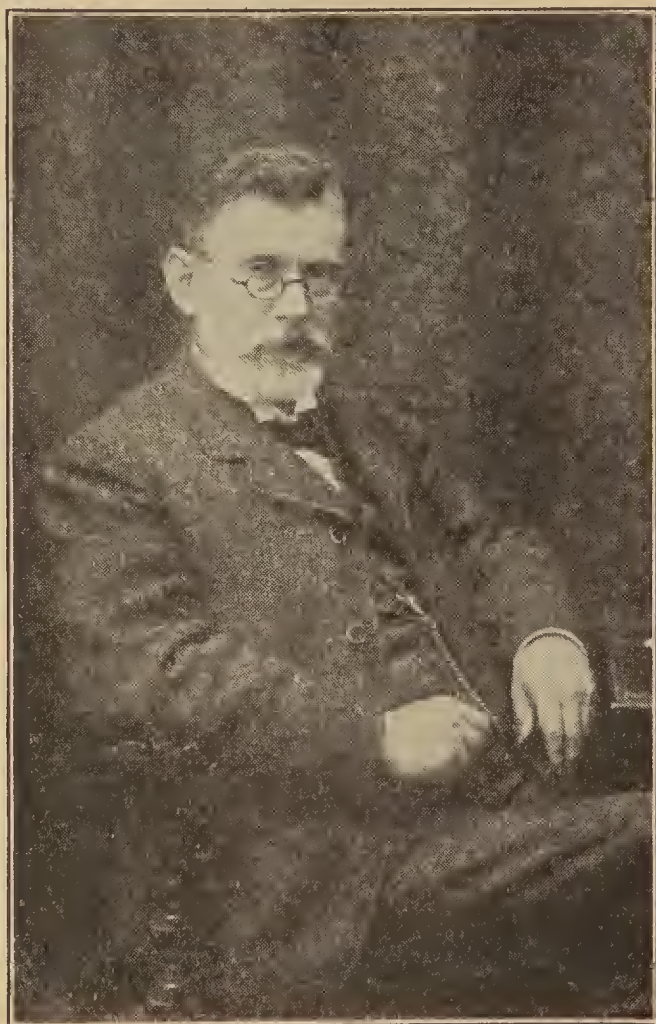


FIGURE 79. — PAUL EHRLICH.

Born in 1854, he was a devoted student of disease-producing germs. His careful and multitudinous experiments resulted in the discovery of salvarsan, a drug which cures some of the worst infectious diseases.

The scalp needs a thorough soap suds bath occasionally. Two or three times a month is regarded as adequate for ladies, whose long hair makes the process rather tedious. Men may well scrub theirs every week, and if they work in dirt and grease, more frequently.

The dead cells of the skin falling off form a white, scaly substance quite normal to the scalp; but excessive dandruff indicates an unhealthy condition. You are more likely to get help in treating it by consulting the doctor than the barber. Most hair dressers advise (from their expert ignorance) the use of whatever tonic they happen to have on their shelves.

The misfortune of baldness is often laid to the stiff hat, — it checks circulation in the scalp, so they tell us. But we are not told that Socrates and Elisha wore the derby. The fact is that the defective condition of the scalp which results in baldness is sometimes due to disease and sometimes inherited. We can do nothing for it other than to keep the scalp as healthy as possible.

The color of the hair is given by pigment (little grains of color) deposited in the middle of the hair. What the color is depends altogether on inheritance, as does the color of the eyes. When the cells which produce the hair cease depositing the pigment, the hair is white. Dying and bleaching are the only methods of altering the color. The hair restorers and all patent dopes are complete frauds, notwithstanding all their glowing testimonials.

Give two good reasons for preserving the hair. How does hair grow? What can we do to keep it growing well? How does cutting affect the hair's growth? What does excessive dandruff indicate? Whom should you ask to treat it? Some young men are bald at twenty-five; is it from wearing tight hats or from the failure to use tonics? What determines the color of one's hair? Can it be naturally changed? What would you say about all advertised hair remedies?

Nails. — The nails of the fingers and toes are of more use than we sometimes think. Fortunately our abuse of them, if it does not extend to the skin cells from which they grow, can be easily remedied. A complete new nail grows in a few months. The habit so many children have of biting the nails short deprives the fingers of a needed protection, makes them stubby and sometimes sore, and unable to pick up small things like pins. The nails themselves recover in a few days if they are allowed to grow. The fingers do not so quickly get over their stubbiness. No matter how style may require a finger nail to be tapering to a rounded

point, for convenient use the nail should be cut as round as the tip of the finger and just a little shorter. If the nails are allowed to get too long, they break or tear back so far as to make them too short for use, and sometimes so far into the attached area as to make them sore. Nails cut best when they have been soaked in warm water. When the nail is dry a file leaves its edge smooth.

FIGURE 80. — A CONTRAST.

The nails of the upper hand have been abused till the tips of the fingers are positively deformed. If the girl who thus mistreats her nails will overcome her bad habit, she will have fingers as shapely and efficient as those on the other hand.

One of the most annoying finger nail defects is the hangnail, a little sliver at the side of the nail. It catches against the sides of pockets and many things that touch the fingers, is bent back and tears the cells at its base. Bacteria get into the tear and produce an irritating inflammation. We should trim off the hangnail and use iodin to disinfect the injury. If the nails are well cared for, the hangnail will be trimmed off when it first starts before it has a chance to split back painfully.

The toe nails should be cut square across and shorter than the flesh, so that they will not press against the toe of the shoe.

Why should children not get the habit of biting their nails? How long should finger nails be cut? How would long toe nails affect the stocking? Name several objections to letting the nails

grow long. What is a hangnail? How should we treat a sore hangnail? How can we prevent the soreness?

Warts. — We commonly consider warts a trivial inconvenience, but sometimes they seriously interfere with work. They are abnormal growths of skin thought to be caused by certain germs. Therefore antiseptics should be used on

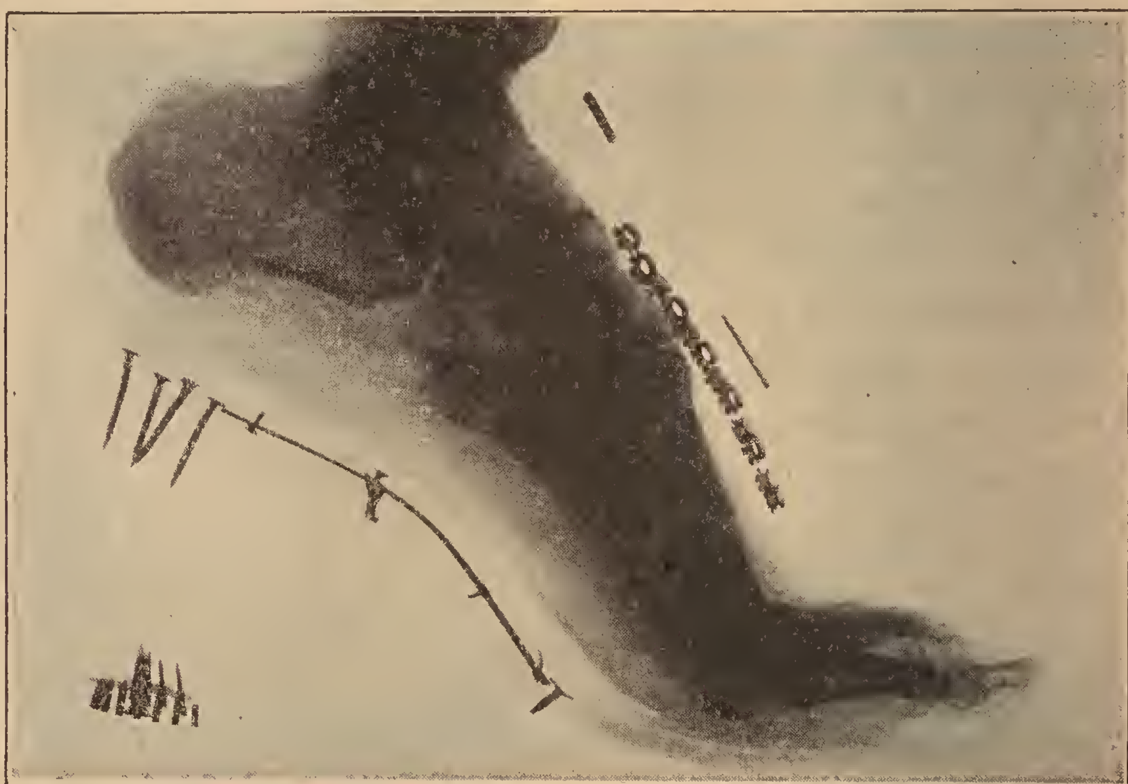


FIGURE 81. — X-RAY OF A FOOT IN A FOOLISH SHOE.

Note the high heel, the bent toes bearing most of the weight of the body, and the leg slanting forward in an awkward position.

them to prevent their spread. A caustic (nitric acid or silver nitrate) may be applied to the wart a few times to kill the tissue. The wart will then drop off. Care should be taken to get no caustic on the healthy skin. The wart is sometimes removed by a physician with a knife or an electric needle.

How is a wart caused? Therefore, what should be done to prevent its spread? How can it be cured?

Shoes. — The article of clothing that abuses us most is the shoe. Thousands of would-be-soldiers were rejected

in the enlistment camps because their feet had been ruined by ill-fitting shoes. Seventy-one per cent of all the men were wearing shoes which were too short; only nineteen per cent had the correct size. Women's feet are abused worse than men's.

The army rule for fitting shoes is a good one. The soldier, with a pack on his back, must stand barefoot on a paper

FIGURE 82. — X-RAY OF A FOOT IN A SENSIBLE SHOE.

Note the low heel which bears a large part of the weight of the body, and the leg rising straight up from the arch.

while the outline of his foot is traced. The shoe must be as wide as the mark on the paper, and must have low heels and thick but flexible soles. In such a shoe, padded with a heavy sock, a soldier's foot can tramp all day without chafe or blister. Corns and bunions will never grow.

Corns are thickenings of the epidermis caused by the pressure of the shoe. They are much like the callouses of the hand, but narrower and thicker. Their abnormal pressure against the tissue beneath makes it inflamed and sore. Corns can be softened and removed by any of the corn-

removing applications. It is more sensible to prevent them by wearing properly fitting shoes. Bunions are abnormal outgrowths of bone stimulated by ill-fitting shoes. They are not only an unsightly deformity but are often sore. Shoes will not fit over them. They can be removed only by a surgical operation.

FIGURE 83. — SHOES.

1. In which shoe could a girl stand and walk with the greater comfort?
2. Which shoe would be more likely to catch in going downstairs?
3. In which shoe would the ankle be more likely to be sprained?

High heels injure not only the feet by throwing too much weight on the toes, thus ramming the toes into the narrow tips of the shoes, but they extend their baneful influence to the whole body. A well-known doctor applies to them the term "fool-killer." The high, narrow heel wobbles and is likely to turn the ankle with result-

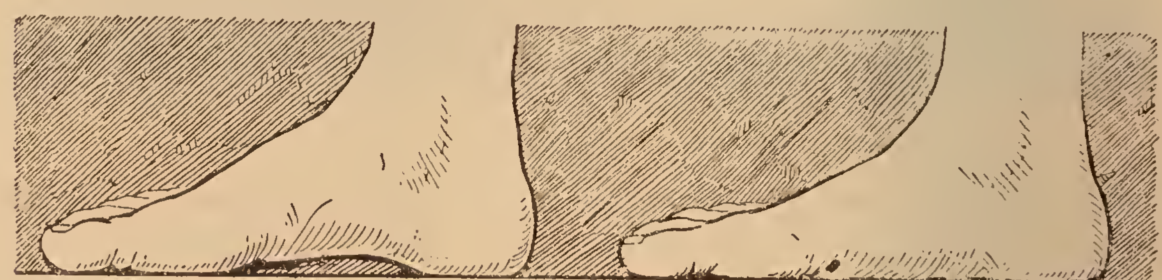


FIGURE 84. — FEET.

The left-hand figure represents a normal foot; the right-hand a weak foot whose arch is down.

ing sprain. It easily catches while going up or down steps and throws its wearer. It prevents straightening the knee in walking and so causes a stubby, ridiculous gait with an awkward carriage of the body. A girl rarely stands straight when she wears high heels. Low, broad, rubber heels are best. *High-heeled shoes are neither socially nor hygienically correct for street use.* A shoe should fit snug

at the heel and be laced at the instep so as to prevent any shucking about. The toes should be loose, not crowded at either side or end.

Ingrowing nails on the great toe are not the fault of the nail but of the narrow shoe crowding the flesh up over the edge of the nail. Relief can be had by separating the corner of the nail from the flesh with a bit of aseptic cotton and by notching the nail in the middle so that the nail can yield when pressed sidewise. A bad case may need the surgeon's aid. Some of our toes are commonly cramped and crowded into painful and unsightly deformities by shoes too tight at the toes. Our only prevention is to care more for good feet than for fancy shoes and select our gear accordingly.

FIGURE 85.— X-RAYS OF ARCHES. Above, a fallen arch; below, the same held up by an artificial support.

The foot forms an arch from the heel to the ball of the foot, the leg bones resting on the top of the curve. This arch "gives" like a spring under the weight of the body at each step. This makes walking easy and light. Sometimes the ligaments of the arch stretch and let the top of the arch down, or the feet become tired because of ill-fitting shoes or too much standing and turn over on the side for ease. This is commonly called flat foot or broken arches; weak foot is a better term.

A weak foot can usually be strengthened by exercise. If your feet are tired and ache at the end of the day, remove your shoes and put on a pair of soft slippers. Bathe and rub the feet; give them thorough massage. Exercise the bare foot by a variety of movements, as follows:

(1) Stand erect and rise on the toes.

(2) Rest the weight on the heels and lift the toes from the floor.

(3) With one foot 12 or 15 inches advanced, and both feet pointing straight forward, rock slowly forward on the toes and backward on the heels: advance the other foot and repeat.

(4) While sitting, with the feet resting gently on the floor, bend the toes under as if you were trying to clutch the carpet; pick up articles with the toes; holding the heels an inch or two from the floor, rotate the toes slowly as nearly in a circle as possible.

FIGURE 86. — BAREFOOT TRACKS.

The tracks (A) were made by a weak foot, — arch fallen, toeing out; (B) by a perfect foot, — arch elevated, toeing straight forward.

If these exercises do not in the course of a few weeks strengthen your feet so that you can get through the day in comfort, consult an orthopedic surgeon. If you just endure the trouble and let it alone, it may become a lifelong weakness, making standing painful and walking a burden. The surgeon can usually relieve and often cure the defect by appliances and special shoes. The shoe clerk will try to sell you arch supports, whether you have good arches or not. An ignorant clerk's advice about such an important member as the foot may do more harm than

good. If anything more than a well-fitting shoe is needed, a surgeon should be consulted.

It is good economy to have two pairs of shoes for daily wear and change them alternate days. The feet are rested by the change, and the shoes will last longer.

Our stockings are commonly too small. They wear longer and are more comfortable if they are as large as they ought to be. With a number 5 shoe we should wear a number 10 stocking, with a 7 shoe an 11 stocking, with a 9 shoe an $11\frac{1}{2}$ stocking, with an 11 shoe a 12 stocking. Wool is best for walking; two pairs at once for a long hike.

Describe a good way of measuring the foot to get a properly fitting shoe. Why are heavy wool socks best for walking? Describe a corn. How is it produced? How can it be cured? Will it recur if the shoes do not fit well? What is a bunion? How can it be cured? What bad effects come from high heels? Where should a shoe be snug? Where loose? How are ingrowing nails caused? How can they be relieved? What is a weak foot? What can be done for it? Why should one wear arch supports only on a physician's advice?

CHAPTER XI

BONE AND MUSCLE

In life's small things be resolute and great
To keep thy muscle trained.

— JAMES RUSSELL LOWELL.

By means of our muscles and bones we have motion, and motion expresses life. By movement also we win the means to sustain life, to improve our conditions of living. It behooves us, then, to keep these organs of movement in good condition.

Nourishment. — We should aim to have our bones and muscles grow to their full development. War-time examinations of the bodies of the young men of the nation revealed, to our consternation, a woeful inadequacy of development in a large part of the population. The chief cause of this defect is inadequate food for children. Milk is a complete food for children the first few months of their lives, and should form a large part of their diet for several years. If good milk is given children in abundance and they share the bread, vegetables, and fruit on the table of the adults, there is little to fear for their nourishment.

But we must remember that children are making bone and muscle and can not grow at their normal rate on such food as sustains life in many adults. When *fresh* milk is wanting in the diet of children, they usually suffer from the lack of vitamines. Vitamines, as has been shown (page 60), can be obtained in fruit, vegetables, and butter, but no food can satisfactorily take the place of milk.

The lack of vitamines is most marked in the child when it results in the disease called *rickets*, which is a lack of de-

velopment of the bones. The bones do not become large and strong — do not have a sufficient deposit of stony matter to make them stiff. Therefore the leg bones bend under the child's weight, causing bow legs or knock knees. The jaw bones are not large enough to make room for the teeth. The teeth are not strong. The imperfect cranium does not give room for a large brain growth. The chest frame is not adequate. The arms are weak. We used to say that the child's food was deficient in the minerals needed by the bones. But to give the medicinal compounds containing the minerals alone did no good. The vitamines are necessary to make the cells of the bone build the minerals into its structure. Young children suffering from rickets can usually be cured by giving them an adequate diet, especially milk. Slightly crooked bones will then grow straight. If the child is neglected until his crooked and under-developed bones eventually harden, a surgical operation may be required to correct the defect.

FIGURE 87. — BOBBY ANDERSON.

This boy, three and a half years old, uses the best food for growing children. In addition to milk he eats bread, vegetables, and fruit.

No special bone food, no special muscle food is required

for the full development of the body, just common proteins, fats, and carbohydrates in a well-balanced ration, with a certainty of mineral salts and vitamines. Sufficient minerals for the bones will be found in bread, vegetables, and milk.

It is not enough for us simply to learn how important

FIGURE 88. — HERCULES AND JASON.

These ancient statues represent two styles of physical excellence, one massive power, the other supple grace. If you have not the possibility of developing the great muscles of a Hercules, you can be just as healthful and efficient in modern life by attaining the form of Jason.

it is that children be well nourished; we must *see* that they are cared for. Tens of thousands of children in our land are growing up stunted and malformed because their parents are too poor or too ignorant to provide properly for them. They are our fellow citizens, who will share with us the life of the community. They will be a burden instead of a

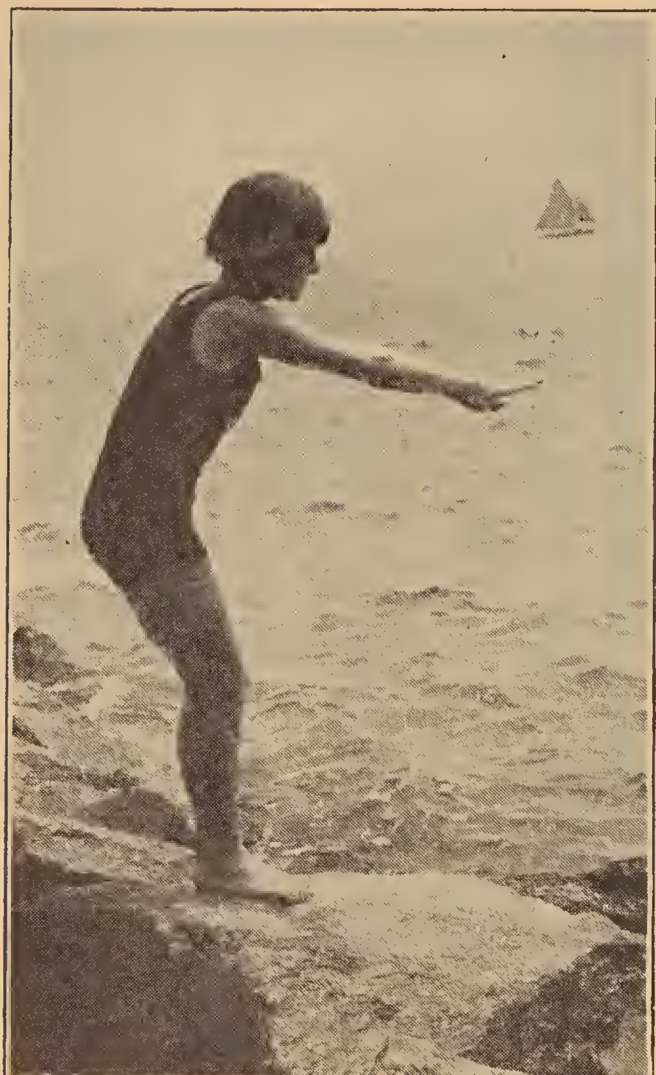
help, if we do nothing to provide for their nourishment now. For our self-protection, if for no other reason, we should devise some plan by which every boy and girl should have the necessities for full development.

What is the chief cause of the lack of full development in so many of our citizens? What bone disease comes from deficient nourishment? By what symptoms is it shown? What one article of diet would largely correct this deficiency? What foods are bone foods? What foods are muscle foods? Whose duty is it to provide for the adequate nourishment of the growing generation?

Exercise. — The human body developed from our lowly ancestors to meet the requirements of primitive man, who had to run and climb and strike, to work nearly all his muscles vigorously, to escape his enemies and win his living. His muscles developed by use; ours now grow by use. If we leave them a long time idle, they waste away, as in paralysis. If our daily work does not require a considerable use of our muscles, we should take exercise to supplement the lack. Our exercise, like the necessary activities of our remote ancestors, should bring into play all our muscles. Exercise benefits not only the muscles of the trunk and limbs but also the heart and the respiratory organs. In fact exercise should be tempered to the condition of the heart even more than to the skeletal muscles.

Exercise should be light at first and gradually increase till it becomes vigorous, with rapid heart beat, full respiration, and perspiration. Play is the best exercise; work is likely to consist of very limited motions, monotonously repeated. Youth has most need of exercise. As age progresses, exercise should decrease in time and vigor, but as long as strength remains exercise will help conserve it and improve the general health. People who are ill, or disabled by accident, or too lazy to exercise, or who because of imperfect heart or nerve system are unable to exercise vigorously, sometimes have massage as a substitute for exercise.

An operator rubs and kneads the muscles to stimulate the circulation through them, moving his hands from the extremities toward the trunk, in the direction of the venous flow. The increased blood supply brings the muscles more food and increases their strength.



Keystone View Co. of N.Y.

FIGURE 89. — A YOUNG CHAMPION.

This thirteen-year-old girl beat seven women competitors in a diving contest. Swimming is one of the best health-promoting sports.

How does the human ancestry indicate the need of exercise? What happens to a muscle that is not used? What besides the muscles of your trunk and limbs is benefited by exercise? What degree of exercise is desirable? Why is play better exercise than work? How does the exercise of middle age and of old age compare with that of youth? What may be employed by invalids in place of exercise? What is one of the ways in which it benefits them? In rubbing the limbs, in what direction should the hands move? Why in this direction?

Games.—Though most young people play games very properly for the fun of it, they should understand the hygienic value of play and choose their games, at least to some extent, with the health end in view. Many times games injure instead of promoting the health of the players. Football is regarded by many advisors as too strenuous a game for high school boys. Their bones and muscles are not yet fully developed and

are therefore more subject to breaks and sprains. Though the boys need vigorous exercise they may be injured by the strain of the game. With a view to relieving the strain of long-continued exertion, the game, formerly played in two halves, is now divided into four quarters with rest periods between.

Almost the same thing may be said of basketball. Both are good games if they are not carried to extremes. Little children rarely have the energy to drive themselves to extremes, but high school and college boys and girls must be careful not to overdo.

Boat racing is one of the most strenuous sports and is a terrific strain on the heart. Exertion at the top notch is maintained for so long a period that the heart is exhausted. It is a common thing for an oarsman to topple over unconscious in the boat. Long-distance running has a similar exhausting effect on the heart.

The track has its dangers also. As a result of long experience physical directors have learned that the younger boys are injured by the longer races. They have fixed a scale about as follows: Boys under 14 years should not run more than 60 yards; under 15 years, 100 yards; under 16 years, 440 yards; under 17 years, 880 yards; under 18 years, 1000 yards; men not over a mile. Girls should be limited to 60 yards. This scale must not be taken to imply that the shorter races are never injurious to the older boys and men. The 440 and the 880 are regarded as most trying to the older runners, because they are run all the way at top speed, while in the longer races the runners slow down part of the time.

Putting the shot is forbidden to boys under 16 years and to girls. It strains the abdomen and is likely to produce *hernia*, a break in the muscular wall through which the intestine protrudes against the skin. Boys of 16 may use the 8 pound shot; boys of 18, the 12 pound; men, the 16 pound.

There are of course occasional accidents in all kinds of games, but some games are comparatively free from the risks in which others abound, and they should receive our preference. There are many such — baseball, indoor ball, soccer, tennis, swimming, rowing (not racing), horseback riding, skating, walking, etc. It brings more muscles into action for a boy or girl to play a variety of games rather than a single game.

A very important consideration in games is that they should be for everybody, not for athletes only. It may be all right at times to have a thousand or ten thousand on the bleachers and eighteen or twenty-two on the field. But to be always on the bleachers and never on the field is poor physical training. Our system of inter-school games has its values, but we must be careful that it does not betray us into giving much attention to those who need it least and little attention to those who need it most. Schools are modifying their scheme somewhat, with a view to bringing more pupils into action, but they should revolutionize it if that is necessary to get everyone into the game.

Give two good reasons for playing games. Name some games which have seriously harmful features. Why may some games be dangerous for high school boys while safe for small boys? What change of rules was made a few years ago for relieving the strain of basketball and football? Name several games in which the players are little likely to overdo or be injured by accident. Why is it better for one not to confine his play to a single game?

Who most need to play games? Suggest some method by which more boys and girls can be brought into the games at school.

Military Training. — When the young men of the nation entered the training camps for the war they were in poor physical condition. When they had finished a few months' training they had ruddy skins, hard muscles, and strong hearts. We saw the benefit derived from the physical training of the camps. With careless reasoning we said we must put military training into our schools and make all our boys

strong. So in some high schools the boys were dressed in uniform, equipped with heavy guns and marched up and down. While a few minutes of such work will do pupils no appreciable injury, it is not a suitable substitute for play. It is stiff and monotonous. The guns are too heavy. Physical directors are generally agreed that the marching and gun drill are inferior means of physical training. They lack most of the desirable elements of exercise.

The soldiers' life in the open air, their setting up exercises, varied activities, and wholesome food gave them their strength and vigor. These conditions are not duplicated in our school military training.

What misled us to think that drill with guns is good physical training for boys? In what way does such military drill fall short of the requirements of good exercise?

Rhythm. — The aim of muscular training is not to make the muscles as hard as possible, able to pull the utmost load. Our ideal is not Sandow, or Hercules, or Ajax. We want our muscles to move with the greatest efficiency in the things we have to do. This includes quickness, fineness, pliancy, rhythm, as well as force. Training the muscles is to a large degree training the nerve system, which controls them. The actions of the two are inseparable. We must not think that muscle training is a lower order of education, fit only for bullies. The Greeks recognized music and dancing as major factors in education. Music *and* dancing, for how can music be fully expressed without the rhythmic movement of the body, and what is dancing but the normal expression of musical emotion? So when we dance we are training ourselves in music, in the appreciation of a beautiful expression of life. Even ballroom dancing has some degree of rhythmic muscular training. Interpretive dancing is more free and aims in the right direction. It is perhaps the precursor of a better system of rhythmic muscular training.

What is the ideal of muscular development? Why should not the prize-fighter and wrestler, though beautifully strong, be taken as the boy's physical ideal? What more than strength is required of muscle? How does rhythmic muscular training harmonize with musical education? Discuss dancing as a means of education. If you enjoy dancing, see if you can tell what there is about it that you like. How can dancing be made a more useful factor in education?

Home Exercise. — For years people have recognized the fact that we need more exercise than we get. Most work requires only limited movements; some of our muscles left inactive, deteriorate. They particularly need to be exercised. Comparatively few of us can go to the gymnasium. We need to exercise at home. To that end many devices have been invented, with elastics, springs, weights, and pulleys, which can be used in one's own room in convenient dress. We have dumbbells, clubs, and wands. There are sets of exercises to be done without apparatus, — the Swedish movements, the Danish movements, and a number of movements devised in this country.

All these things are good, but they lack the element of play; there is no zest in them. If a few people can do them together, they have the added interest of sociability and are done with more spirit. The exercises without apparatus are to be preferred; they cost nothing and are rather more flexible and varied. If one forms the habit of going through certain exercises before getting into bed (or upon rising in the morning) just as he has the habit of cleaning his teeth, he will find it takes no special effort to bring himself to do them, and that his sleep will be better and his body fitter.

If we have considerable physical work, what muscles still need exercise? Why do we need something in addition to gymnasium work for exercise? What is the preferred means of exercising in one's own room? Should the windows be open during the exercise? How can we put a little of the play spirit into such exercise? What can we do to insure its regular performance? (Let the teacher go through with the class such exercises as are illus-

trated by Figure 90; then ask the pupils to do them every evening for three months. The movements should be slow and accompanied by deep breathing. While the habit is being formed

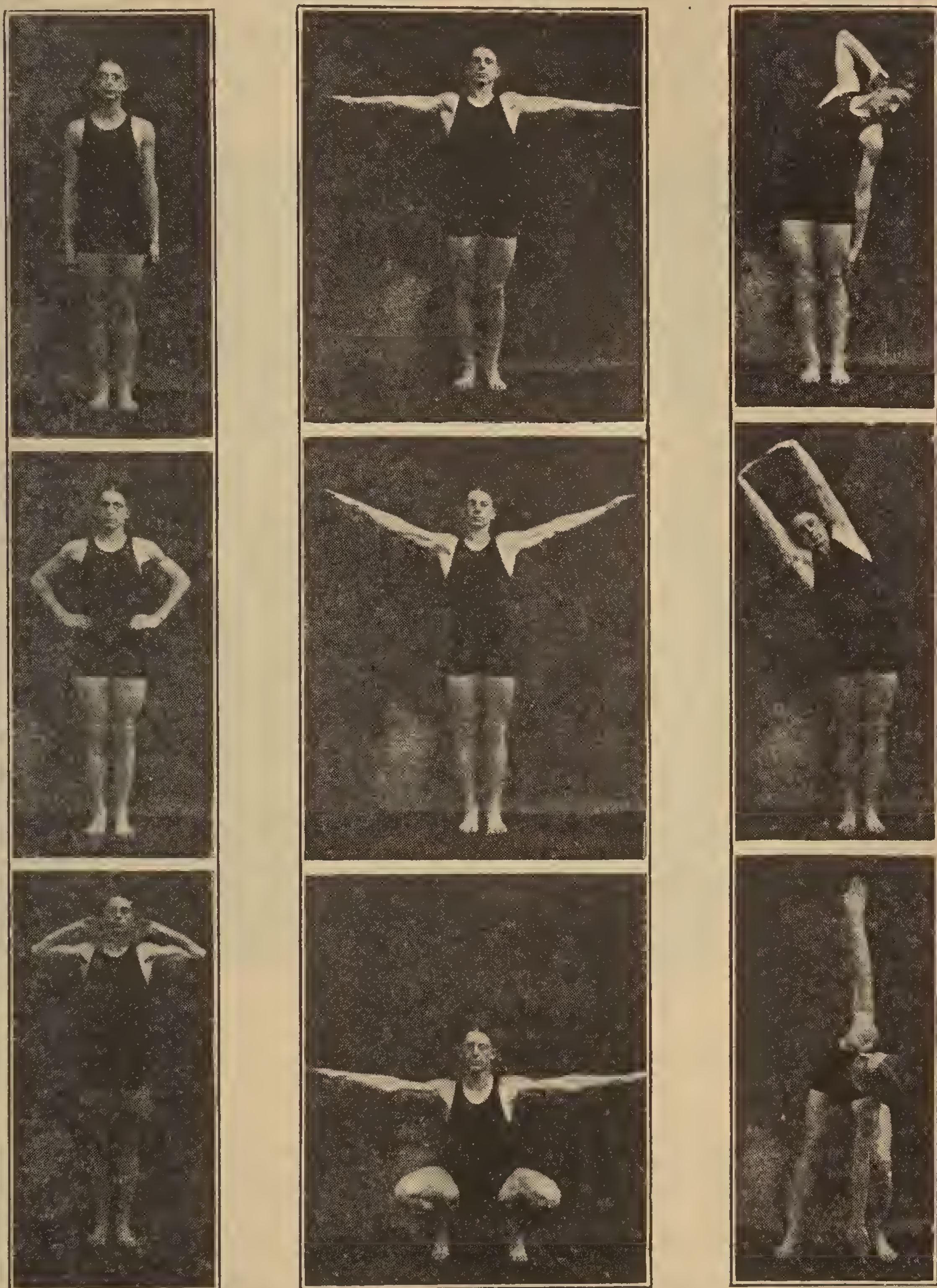


FIGURE 90. — HOME EXERCISES.

some effort must be made to stimulate interest in the undertaking. To this end write the names of all the pupils on a score card with a blank square after each name for each day of the month, and

have each pupil when he comes to the class make a check mark in the square of the preceding day if he went through the exercise.)

Posture. — Why do we like to see a girl or a boy standing straight with head erect and walking with a springy forceful step? We do not perhaps think out the reason. If

FIGURE 91. — STAND STRAIGHT.

Point out the particulars in which one of these postures is superior to the other two.

we did, we should find it to lie in the fact that posture portrays character. Sound health, a cheerful disposition, good will to others, courage, and ambition, normally express themselves in a fine, upstanding body. Moreover, an upright body allows free movement of the organs of the abdomen, while a stooping position cramps them and interferes with the blood circulation.

We know, too, that the attitude of the body influences the state of the mind. If you assume the attitude and aspect of a fighter, you feel pugnacious. If you take on the limp and wilted attitude of exhaustion, you feel "all in." So if you sit and stand and walk in the posture of one who is strong and courageous and cheerful, it will add to your efficiency and make the world bright and rosy for you.

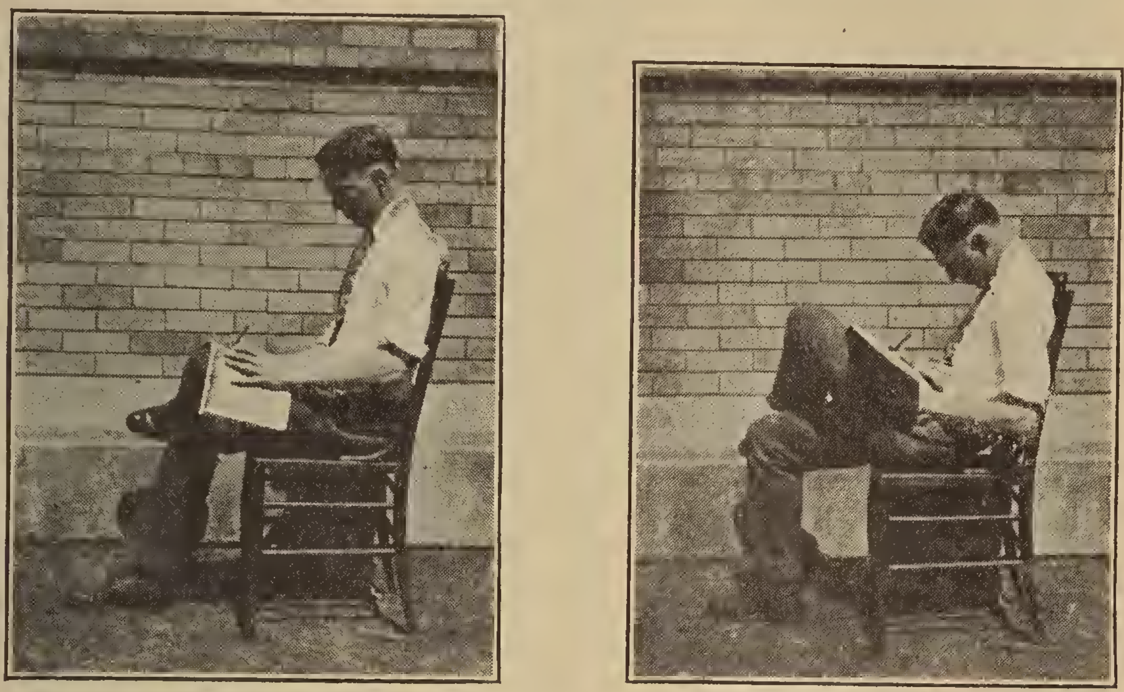


FIGURE 92. — SIT STRAIGHT.

Point out the particulars in which one position is better than the other.

In sitting you should be able to rest both feet flat on the floor, your knees slightly lower than your hips, without resting the thighs heavily on the front of the chair seat. You should sit well back in the seat so that your back lightly touches the back of the chair. At the desk, the front edge of the seat should underlap the edge of the desk not more than an inch. The desk should be at the height of your elbow as you sit up straight. If your seat and desk at school are adjustable, have them adjusted to fit you. At home try to find a chair that is your size and use it.

In sitting and standing and walking hold the body and head erect, but avoid a strained attitude. A good way to

get the correct posture is to imagine you are holding a weight on your chest; then try to react against this weight and to feel yourself strong enough to hold up a very heavy weight. Keep the abdomen well back. This will give

FIGURE 93. — HYGIENIC DESKS.

These chair desks are made in several sizes so that each pupil can be fitted with a desk that will enable him to maintain a good posture. Notice, too, that the floor is clean, as it rarely is under a desk that is fastened down.

you a good carriage which, though at first it may seem forced and awkward, will soon become easy, natural, graceful, and dignified.

Why is a boy or girl who stands up well more pleasing to see than one who stoops? How does a bent posture interfere with our organic activities? Explain how the attitude of the body affects the character. How high should your chair and your desk be? Describe a good position in sitting. What suggestion for the carriage of the body will help to make your posture healthful and pleasing?

(The teacher should not be content when the pupil has only learned to recite this lesson on posture. He should insist that the pupil bear himself in the correct attitude until it becomes a habit.)

Joints. — The joints are the most vulnerable parts of the skeleton. Injury to them is serious because it may interfere with their freedom of movement. If the two bones

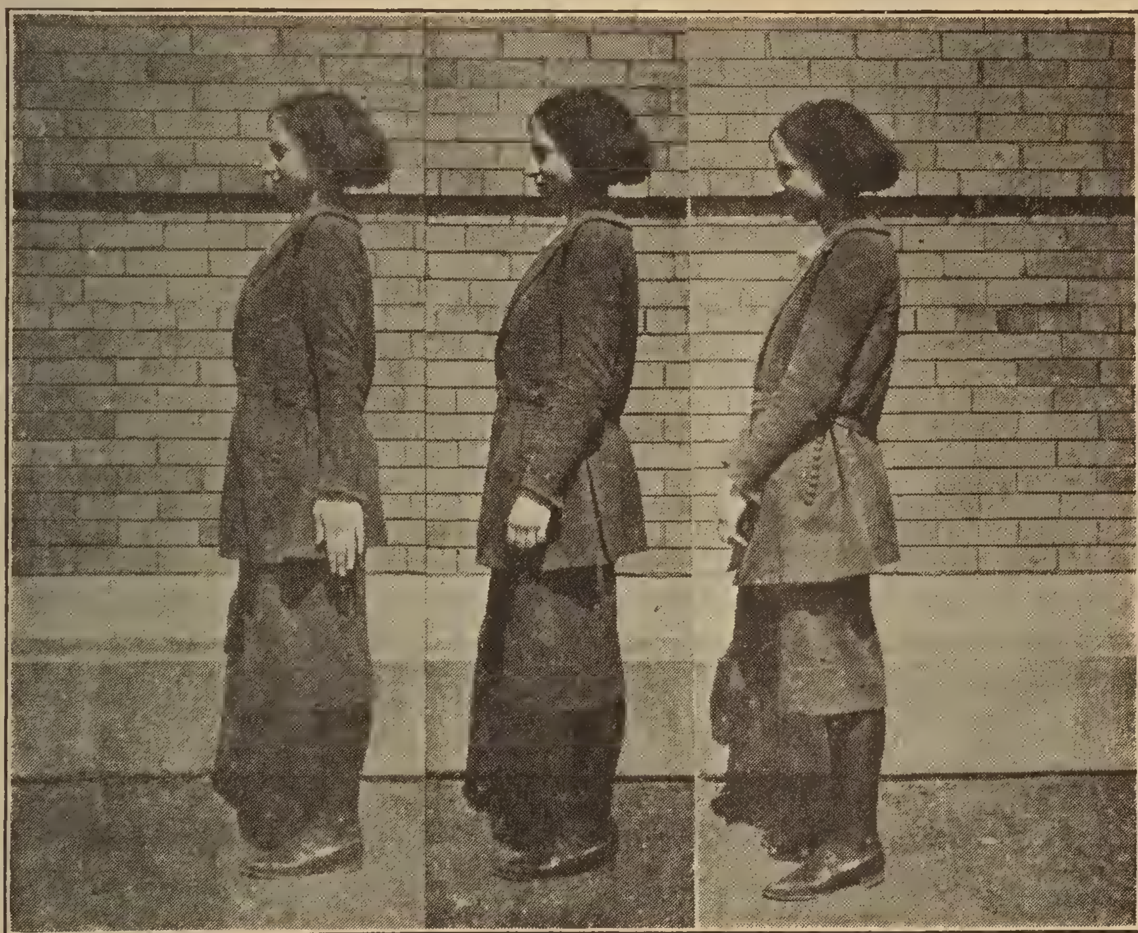


FIGURE 94. — A GOOD BEARING.

In which picture does the girl have the best carriage? In what ways is it better than the others?

at the joint are slipped out of their normal bearings on each other, the injury is called a *dislocation*. When the cartilage is bruised or the ligaments are torn, the injury is painful and is called a *sprain*. Dislocations commonly produce sprains. The joint swells and is tender for several days. If no bacterial infection occurs the injury heals without serious results. It should have a physician's care if it is bad, lest

improper treatment result in permanent stiffness. Swelling can be reduced and pain relieved by wet bandages as hot as can be borne, changed three or four times an hour. A sprain should be bandaged and kept quiet that the injured tissue may have a chance to heal.

The synovial membrane, which forms a closed sac lining the joint cavity, is a tough tissue with a smooth surface.

FIGURE 95. — HOW TO LEAN FORWARD.

Sit well back in the chair and lean forward from the hips.

It secretes a small quantity of synovial fluid which keeps the joint surface always slippery. Injuries to the joint sometimes cause a large secretion of this fluid till the synovial sac is distended with it, as in the case of " water on the knee."

Infections of the tonsils, of nasal sinuses or abscesses at the roots of the teeth are likely to result in pain and swelling of the joints (arthritis) even in distant parts of the body.

The germs or their toxins are carried from the point of infection by the blood. Pulling the abscessed tooth, and draining the cavity if necessary, removing the tonsils, or draining the sinus usually relieves the arthritis. Rheumatism is an infection of the joints or muscles with swelling and usually great pain in movement. It often develops from tonsil or tooth infections.

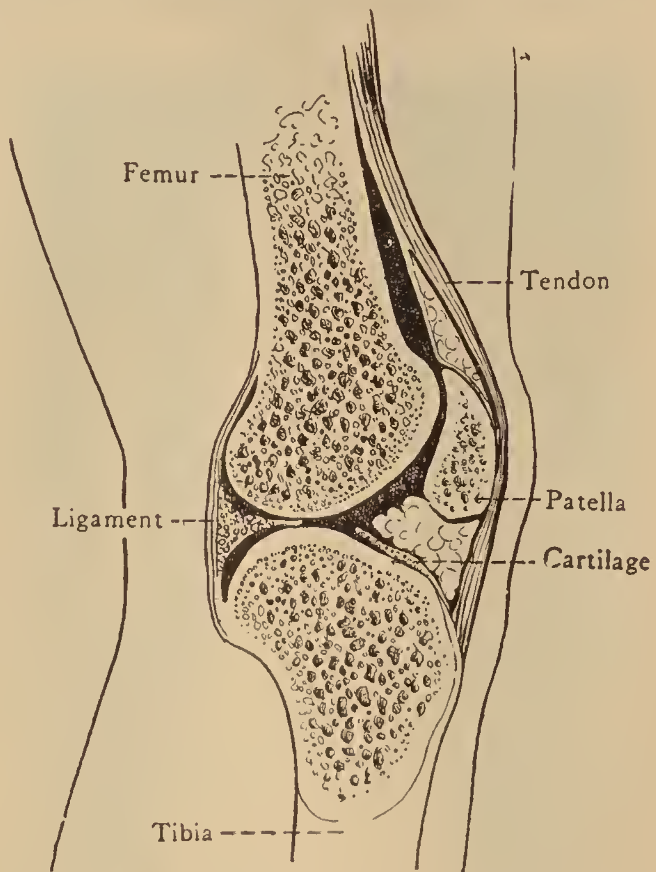


FIGURE 96. — SECTION THROUGH THE KNEE JOINT.

The tendon running upward from the patella extends to a large muscle in the front of the thigh. The irregular black area represents the synovial sac.

1. On the end of what bone does the patella slide when you bend the knee?

2. What bones does the ligament bind together?

3. What is the name of the tissue which covers the bones at their ends?

What is a dislocation? What is a sprain? How can the pain and swelling of a sprain be relieved? Why is a sprain bandaged and kept quiet? Why should a surgeon be called to take care of a severe sprain?

What keeps the joint lubricated? What is "water on the knee"?

What is arthritis? What causes it? How is it commonly relieved? What is rheumatism?

A Broken Bone. — In case of a broken bone the surgeon should be called as soon as possible, and the bone kept perfectly still until he takes it in charge. He first fits the broken ends together, and then keeps them bound in place while the fracture heals. Usually splints are applied on the outside of the limb, or a plaster of Paris cast is made. To hold the bones more securely the surgeon sometimes cuts down to the bone and

fastens a metal plate across the break, holding it with screws set in the bone.

If the tissue around the break is much swollen, the surgeon has difficulty in feeling the ends of the bone and knowing when they are perfectly matched; hence the imperfect result sometimes obtained. The X-ray and the fluoroscope are great aids in modern bone surgery. They show just how the bone lies. If the doctor sees the ends of the bone are not perfectly matched together he can try again.

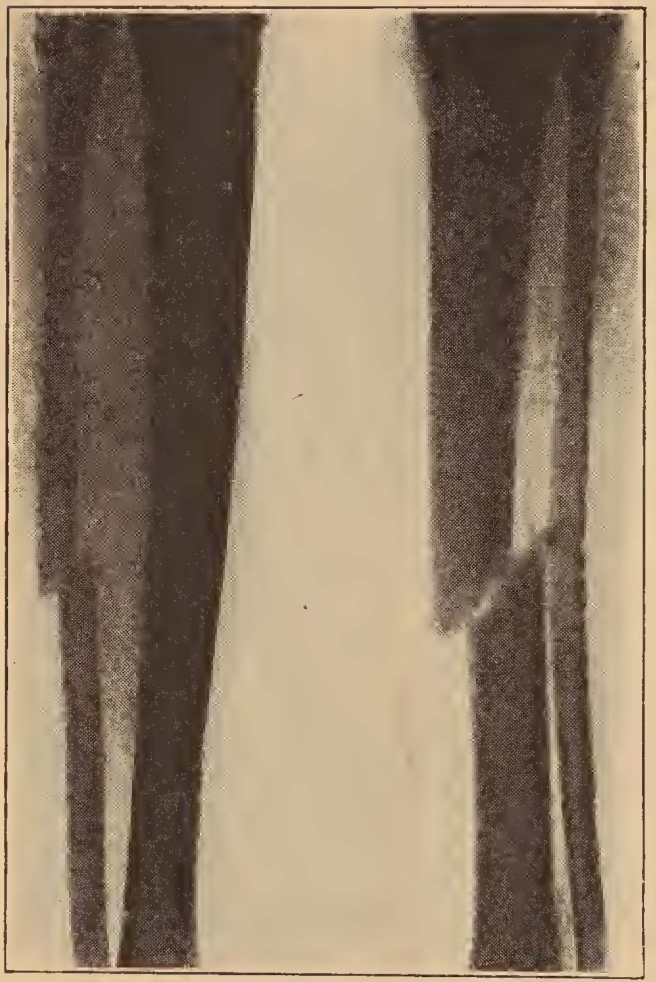


FIGURE 97. — BOTH LEGS BROKEN.

If the breaks are left to heal as they are how will they affect the lengths of the bones?

The patient's care is to keep the limb quiet till the bone is firmly healed. After the swelling goes down and the pain ceases the patient may think the injury is healed. If he starts to use the limb too soon, he is likely to bend it at the break and delay its healing.

The process of healing is as follows: There is a tough membrane (*perios'teum*) covering the bone everywhere except at the joint. When the broken bone is set, the cells of this membrane multiply and fill all the little spaces between the broken ends, a live cement. But it is a soft cement easily broken. These periosteum cells in time deposit around themselves the gristly and the stony intercellular material of the bone and thus become bone cells. When

the deposit is complete, after several weeks, the bone is as strong as ever. The danger lies in using it too soon, before the stony deposit is complete.

While waiting for the doctor what should we do with a broken bone? What does the doctor do in "setting" a broken bone? Why does he use splints? What is the periosteum? How does a bone heal? What danger is there in using a broken limb too soon after it seems healed? Is it ready for use as soon as the pain has ceased and the swelling disappears?

Bone Infections. — Sometimes pus-forming bacteria get under the periosteum and form an abscess called a *felon.* The pain and swelling of a felon is extreme. This injury is most common at the end of a finger or thumb. It is supposed to come where the membrane is injured by a bruise. If let alone the germs may work into the bone and destroy considerable of it before they finally break out through the membrane and skin. This results in a deformed finger. A felon should be cut to the bone when it first appears, before it has time to become extremely painful and to injure the bone. If it is promptly opened it drains and heals quickly and leaves the finger unimpaired.

Tuberculosis and leprosy are well-known diseases whose germs destroy bone. For centuries leprosy has been considered incurable and has been regarded with the utmost horror. At last a drug has been discovered which seems to cure it. Tuberculous spots are removed from bone by surgical operation. But the best procedure with these infectious diseases is prevention. As individuals we can to considerable degree avoid their germs, but it is always possible that the germs will reach us through unknown channels. We need the coöperation of government in a campaign to exterminate the germs.

What is a felon? How serious an injury does it often produce? What should be done with it? Name some diseases that destroy bone. How can they be cured? What is better than cure? Why must the aid of government be invoked in this work?

CHAPTER XII

THE NERVE SYSTEM

He that wrestles with us strengthens our nerves and sharpens our skill.

— EDMUND BURKE.

The body itself cares for the nerve system as though it recognized the vital importance of that structure in the body economy. The great centers of the system, the brain and spinal cord, are encased in a bony covering which gives them better protection than any other organ of the body has. When the body is short of food the fat disappears, the muscles waste away, and their substance goes to feed the nerve centers, which must be sustained at all cost. In our voluntary activities also we should do well to follow the example of the automatic forces and take especial care of the ruler of the body.

How the Brain Controls the Body. — The nerve system may be likened to a telephone exchange, with the brain for "central" office. (1) From your home you may call central, or (2) the operator may call you, or (3) you may call a friend by connection through the central office. Just so (1) messages may come to the brain from any part of the body, (2) the brain may originate and send out messages to any part of the body, or (3) a current from some part of the body to the brain may be reflected out to some other part. The central station or switch board of this nerve telephone system is composed of the ganglion cells which are situated in the gray matter, a comparatively thin layer at the surface of the brain.

This gray matter, *as a governing center*, is divided up into many small areas, each of which is connected by nerve threads (axons) with its own particular part of the body. To illustrate, a certain spot at the top of the brain is connected with the muscles that move the thumb. When we wish to bend the thumb some of the cells of this spot send

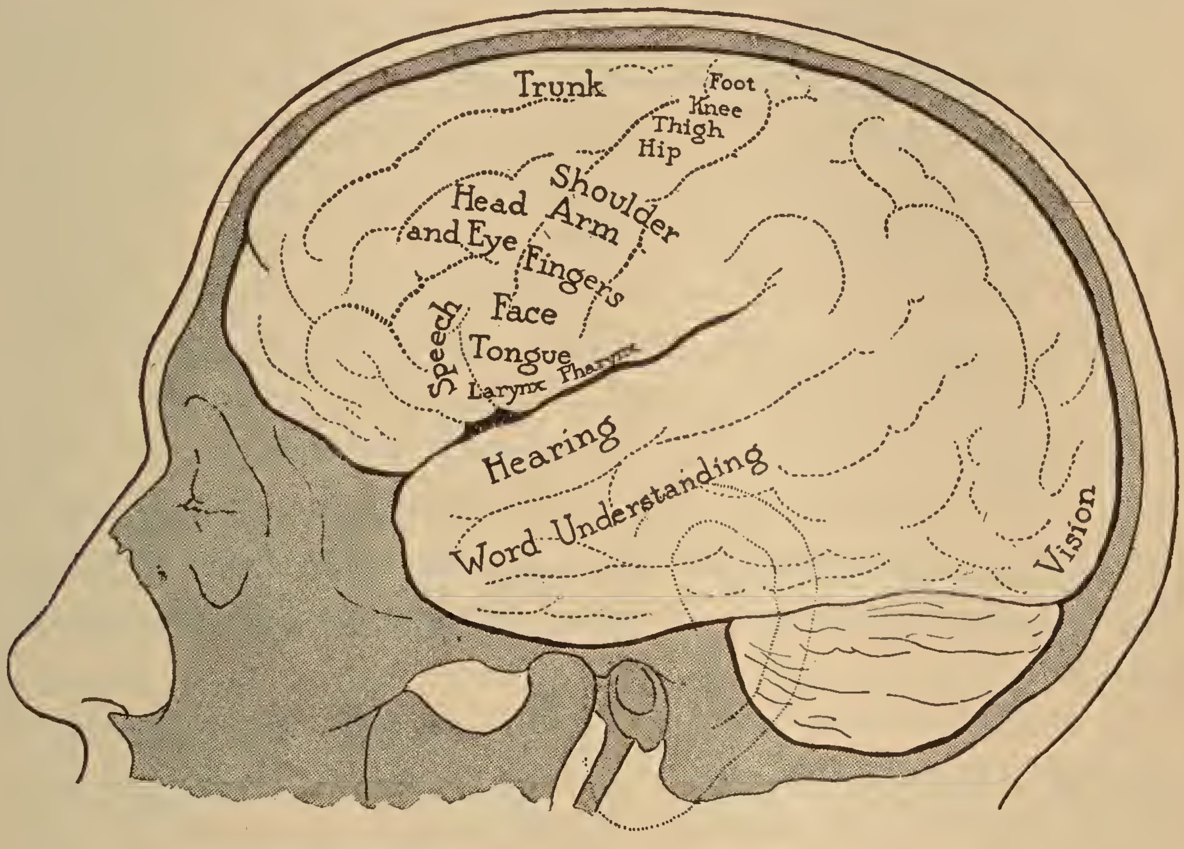


FIGURE 98. — FUNCTIONAL AREAS OF THE CEREBRUM.

The words vision, hearing, speech, etc., show the part of the brain which acts when we see, when we hear, when we speak, etc.

nerve currents over their axons to the muscles of the thumb and cause them to contract. So every muscle of the body which can be moved voluntarily is connected with its own special area in the *cer′ebrum* and moves when it receives orders from the ganglion cells of this area.

The gray matter of the brain, *as a receiving center* for the sense organs, is likewise divided up into areas. One of these receives currents from the eye, another from the ear, another from the nose, and so on. Each small spot in the skin has its own receiving station in the cerebrum to which it sends

currents when it is touched or when it receives a warm or a cool impression. For example, when you touch a hot cup of cocoa the skin which comes in contact with the cup sends a nerve current up through the arm and cord to its own particular area in the brain. When the current reaches the cerebrum you feel the warmth of the cup.

The entire distance from the brain to the hands or feet is not spanned by a single axon. The current is "relayed" in the spinal cord. If the current is from the cerebrum to a muscle in the hand, the first axon reaches from the brain to the spinal cord at the height of the shoulder. There it joins a cell in the cord whose axon extends to the muscle. So also a current in the opposite direction is relayed in the cord. One long nerve thread reaches from the finger to the cord, where it joins a cell whose axon extends to the cerebrum or to still another cell which relays the current on to the brain. Currents from sense organs in the head go either directly to the brain or to small ganglia and thence to the brain.

In *voluntary movements* of the trunk and limbs the nerve currents start in the cerebrum and go down the spinal cord till they reach the battery of cells which immediately control the muscle to be moved. This battery is thus stimulated to action and sends into the muscle the current which results in the motion.

In *involuntary contractions* of muscles the batteries of cells which immediately control these muscles are set off by currents originating in sources other than the cerebrum. Sometimes a current caused by some outside stimulus starts in the skin, goes to receiving cells in the cord, and then immediately to the muscle-moving cells. The resulting movement of the muscle is called a simple *reflex action*, — in contrast to the voluntary action caused by a cerebral current. To illustrate, when the foot of a sleeping person is touched the nerve current goes from the skin to the cord and thence

to the muscle which moves the foot, and the brain is not involved. A reflex action may occur in the head, as when an object moves suddenly toward the eye the lids are closed by means of a current which goes into and reflects from a minor ganglion, not from the cerebrum.

Though the *automatic activities* of the body, such as the workings of the heart and blood vessels, the stomach and intestines, and the secretions of the glands, are directly under the control of the small autonomic centers, these are connected with the spinal cord and with the brain. The whole nerve system is *one* and by its rule brings the activities of the body into harmony.

An interesting example of the influence of the cerebrum on the automatic activities is seen in the simple act of licking a postage stamp to put on your letter. The salivary glands are automatic, that is, outside the control of the will; but when you think a moment about licking the stamp, nerve currents from the cerebrum go to the lower centers and through their action produce a large flow of saliva to wet the gum on the stamp.

In what two ways does the body take care of the nervous system? In what two capacities does the gray matter of the brain act? How is its area divided for both purposes? What is an axon? What do we mean when we say that a nerve current from the cerebrum is relayed in the spinal cord? Explain how the automatic activities of the body are harmonized with the other activities.

Narcotics and Stimulants. — Without being aware of the injury we are doing, most of us abuse our nerve system by the use of stimulants and narcotics. The nerve system, more than other organs of the body, feels the effects of these drugs. The control of the body at its best is a difficult job, requiring the most delicate adjustments of blood supply, of gland secretions, and of muscular contractions. The brain and minor ganglia usually get along fairly well when allowed to function normally. But we come along

with tea and coffee, alcohol, tobacco, and worse drugs and upset the fine adjustments. The enduring nerve cells make up for our stupidity by resuming their natural activities as soon as the drug is removed, unless they are too badly injured.

The effects of tea, coffee, alcohol, and tobacco, used *in moderation*, are revealed by scientific tests, but are not noticeable to a casual observer. Therefore, these enemies of our nerve system are not condemned in the court of public opinion as they deserve to be.

The *excessive use* of narcotics works havoc with both the brain and the autonomic centers. When the brain cells of the drunkard are thoroughly ruined by alcohol he is likely to die of *delirium tremens*. The muscle-controlling centers of the inveterate smoker are so deadened by nicotine that his hand is in constant tremor. Worst of all, are the narcotics (alcohol, opium, etc.) whose inordinate use deranges the thinking function so that the mind is temporarily crazed or goes permanently insane.

What tissue suffers most from stimulants and narcotics? What activities are deranged by poisoning their ruler? Do the brain cells usually recover if the use of the drug is stopped? Why do we tolerate a moderate use of habit-forming drugs? What is delirium tremens? How does the excessive use of tobacco affect the brain's control of muscles? What is a common cause of insanity?

Infections. — Though the nerve system is much less open to the invasion of disease germs than are the digestive tract and the organs of respiration, it is in serious danger when it is attacked. The nerves of smell come to the surface of the mucous membrane in the nose. They furnish a short passageway from the upper part of the nose to the brain. Germs which are able to use this route can penetrate the brain chamber and grow in the membranes (meninges) covering the brain, producing *brain fever* or *meningitis*. (" Brain fever " does not come from over-working the brain.

Do not be afraid of hard study.) The germ growth causing meningitis easily extends down the spinal cord, whose meninges are continuous with those of the brain, and produces *spinal meningi'tis.* The germs of infantile paralysis also are thought to invade the brain chamber by way of the nerves of smell.

Transmission of the germs of these diseases does not seem to be very easy, yet we should observe the general rule for infectious diseases, isolation of the sick and disinfection of the things used in the sick room.

Paralysis is a loss of the power of motion or of sensation. Sometimes only a small part of the body is affected, often an arm or a leg on one side or both sides of the body. Its cause may be an injury by accident, or disease germs; in some cases it is unknown. Recovery is possible in many cases.

Neural'gia is an ache, more or less continuous and often excruciating, commonly in the nerves of the face. It is often caused by bacterial toxins, — it may be a tooth abscess or tonsil infection. If the source of the infection can be found, the trouble can usually be relieved.

By what avenue do germs invade the brain chamber? What is meningitis? Germs of what other disease are thought to enter along the nerves of smell? What general precautions should be taken to prevent the spread of these diseases? What is paralysis? How is it caused? What is neuralgia? What is its usual cause?

Food Insufficiency. — Though the brain endures starvation while muscles waste away, it is affected by even a slight insufficiency of food. The adult brain does not function at its best, does not recover rapidly from wear except when it is abundantly supplied with food. The child brain does not grow normally when deficiently nourished. The brain uses the same kinds of food that the other tissues use, — sugar, fat, and protein with small quantities of the mineral salts. Though some elements are found in the brain in

slightly larger proportion than in other tissues, that does not need to be considered in choosing our food.

The " brain foods " are fakes. Their supposed superiority is pure imagination or unsupported tradition. If one has plenty of food, about one sixth protein and the necessary small quantity of vitamines, his brain, as well as other organs, will get what it needs.

But the most deplorable fact is that the nerve systems of tens of thousands of children of our land are not developing to their full because of the lack of nourishment. When these children grow up their brains will be unable to control perfectly their activities. They will get less out of life and be less valuable members of the community because they now lack food. It is our business as individuals and as an organized government to remedy this evil.

How does insufficiency of food affect the adult brain? How does it affect the child's brain? What food does the brain need? Why does the Board of Education in some cities supply lunch free to pupils who can not pay for it? Why do we specify that much of our food donations to starving Europe shall go to the children?

Sleep. — We know well that nature's kind restorer, sleep, is a necessity to the nerve system. In physical work as well as in mental activity the brain is oxidized. At the end of a hard day's labor the brain cells look ragged and shrunk. During sleep they take food from the blood and build up new molecules in place of those burned up. In the morning they are plump and smooth. The younger we are the more sleep we need. Precise figures can not be applied to all alike, yet we can say in general that elementary school children should have ten to twelve hours, high school pupils nine or more hours, adults seven to eight. The sleep should be quiet and undisturbed; therefore night is a better time for it than day. The less dreaming the better.

If we live hygienically we are likely to sleep well. Hence, if we are not sleeping peacefully we should overhaul our

method of living and see if we can make it more hygienic. Indigestion often disturbs sleep, as does a discomfort in any part of the body.

If the brain is crowded with blood it is more likely to be active than when its blood supply is small. If the mind is so alert when we go to bed that we can not sleep, we may find rest by inducing the blood to flow in larger quantities to other organs. A light, easily digested lunch may call the blood to the stomach. A hot foot bath or a warm tub will bring the blood to the feet or skin. Gentle massage or light gymnastics or a dry rub will help to relieve the brain of blood. If hard mental work in the evening leaves the brain so congested that sleep does not come, it may be necessary to have only light occupation in the evening and save the heavy tasks for morning.

Above all we should not resort to drugs to induce sleep. There are a number of narcotics which will benumb the brain cells and bring sleep. Although it is better than no sleep it is not so restful as natural sleep. Doctors have occasion to use these drugs when patients can not otherwise sleep, but we should leave their use to the physician. The drugs are insidious habit-formers; we should keep free from their clutches.

What change in the brain cells does a day's work produce? What effect on the cells is produced by sleep? How many hours should elementary school children sleep? How many hours should high school boys and girls sleep? How many hours should adults sleep? Why is it better to sleep at night than in the day time? Why should municipal governments check noises at night? Name several influences that disturb sleep. Name several devices that help to induce sleep, and explain how each works. Why is it better to do your hard lessons in the morning? What means of producing sleep should we avoid?

Brain Currents. — For each thing we think or do there are nerve currents running through certain cells and fibers of the brain. The action is illustrated by Figure 99. When

a brain cell (A) oxidizes, it shoots a current out over its axon (a). The axon has several or many branches, each leading to another cell. The nerve current which is sent out over the axon spreads through the branches, but not with equal force in all. We will suppose it is stronger in (a) and weaker in (x). It may fade out altogether and produce no noticeable result. If the current is strong it will extend to another cell (B), which it stimulates to oxidize (explode) with a resulting current to still another cell (C), — and so the chain of explosions goes on, and we have certain thoughts or muscular actions, depending on just what cells are involved.

FIGURE 99. — NERVE CURRENTS.

These brain cells illustrate the way in which nerve currents from a cell may be turned into different courses and produce different results.

A current from B to D would produce a result different from that caused by a current from B to C. Suppose M represents a muscle which moves one finger and M' a muscle which moves another finger. By willing to move the first finger, we direct the nerve current to M; and by willing to move the other finger, we direct the current to M'. The movement we will is obediently made.

As it seems to us, we can direct the chain of explosions to an end we desire by thinking of the thing we wish — thinking not idly but in the way we call *will-to-do*. We do not concern ourselves directly with the cell explosions and

nerve currents, but with the earnest effort to think or do. The details of the cell action conform themselves to the end we strive for. If we will to do, try hard enough to do, we can direct the nerve current successfully to the end we have in mind.

What occurs in the brain when we think or act? How are nerve currents caused? Where do they go? What becomes of the nerve current when the impulse that causes it is very weak? When the impulse is strong? How do we direct the course of nerve currents?

Habit. — The first time a nerve current goes over a path to an end we determine, it goes with difficulty and only as we make an earnest endeavor. As we repeat the act the path becomes worn and the current is not likely to go off on any side branches, as it was at first. When the path becomes so well worn that the current goes over it with ease we have established a habit. In Figure 99, for example, if we always use the first finger in a certain action the nerve current gets a path worn from *B* to *C*, and it will not branch off to *D*.

Since things done by habit are easily done we can economize energy by forming habits in doing what we have to do. We should first work out the best way of doing the things we have to do regularly, and do them this way till we get the habit. Then they almost do themselves, and we can give our attention to forming new habits. The more good habits we have the more efficient is our work.

Bad habits are contracted in the same way that good habits are established, by repeated doing till nerve paths are worn in the brain. Bad habits are particularly harmful in that they are done so easily, without our attention, and are thus slyly making themselves stronger. To overcome a bad habit we must substitute a good habit in its place.

To illustrate: When some one does something which irritates you your impulse is to speak sharply to him. If you

do so repeatedly you get the habit of impatient speech. To break the bad habit fix in your mind the determination to speak gently (though perhaps firmly) to the annoyer. Bring this determination repeatedly to your mind. Strengthen it by imaging the good results which will spring from such speech. If you hold this end persistently before you, the nerve currents will take the new course which will result in the desired act, and will in time wear such a path that courteous speech will be as easy as scolding formerly was.

Our will-to-do must be on guard, and when the nerve currents which work out to the undesired end start, we must switch them to an end we want. We must hold before ourselves, and strive so hard to attain a substitute good action that the nerve current will be forced to abandon its old path and make a new one. If by constant striving we always hold the nerve current to the new path, the latter will soon become so worn that the current will follow it easily — and we have a good habit substituted for a bad one.

How does the first passage of a nerve current over a path compare with its tenth passage over the same path? How are habits formed? What advantage is there in having routine work done by habit? Name half a dozen good things you do from habit, with hardly any attention. How are bad habits made stronger without attracting our attention? How can we correct a bad habit? Illustrate by naming several bad habits and the good practices you would substitute for them.

Some Good Habits. — A person who has a steady job gets the habit at a certain hour of settling down to work. He doesn't need to summon up any determination to get himself started. He gets busy without any special thought or the expenditure of much energy, — an economical proceeding.

Your school tasks should be managed in some such way. Have certain times for study. When the time arrives settle down to work. Don't let yourself think of anything but your lesson. At first it will be somewhat difficult, but soon you will get the habit and be surprised to find how easy it is to study.

After work we need rest, sleep, recreation. The times for them should be observed and not lightly broken up. We are in especial danger of falling into bad habits during the recreation time. We do whatever we just happen to do, thinking that it is quite proper to spend leisure time so. Often we get to doing wasteful or harmful things. Our recreation ought to be restful and enjoyable, but it should at the same time enrich our lives. We should plan to do something worth while in our recreation hours, to have some hobby which we can trot out and ride as a recreation habit.

Our mental states have a tremendous influence over our health. We should take an inventory of ourselves and see that our habitual states are those that conduce to good health. If we find that we repeatedly worry, or are irascible, or are jealous, or become angry, or nurse grudges, or entertain fears, we know that we have some bad habits to break — habits which will probably in time ruin our digestion and undermine our health. We must break up the bad habits by substituting in their places good cheer, a placid spirit, confidence, friendliness, generosity, courage. We must hold these healthful states of mind so much before us that they become our habits.

Explain the economy of having a regular habit of work. What would be your best plan for study? Why is it important that we carefully plan our recreational habits? Explain how our health can be promoted by our cultivating desirable states of mind.

Education. — A large part of education consists in establishing good habits. No one can educate you; you must educate yourself by your own activity. You make the paths in your brain. If you leave the matter to chance, paths to undesired ends are likely to form; and once formed, they are difficult to change. A very large part of our school work consists in breaking bad habits — the more reason for taking pains to form good habits in the beginning. The work of the teacher is to help you find and plan lines of activity

within your powers, to guide you in your practice that your good habits may become securely established, and by precept and example to help you distinguish good habits from such as are bad so that your aim may be true.

FIGURE 100. — A BIRD HAUNT.

A restful recreation for jaded nerves is a stroll through such a dell as this, getting acquainted with the shy birds and storing the mind with beautiful scenes whose memory will gladden many moments of recollection.

Why must your education be the result of your own activity? Why is it important that one's early education be carefully directed? Why does the character of a pupil's work the first month of the semester indicate what it will be later? How can teachers help you educate yourself?

Overwork. — We hear a great deal about people who break down from overwork, especially mental work. There is a degree of truth in the phrase, but it directs the attention to the wrong place and so is misleading. People who do heavy mental work, in office or shop or school, often deteriorate in health, not so much because of the quantity of work they do as because they fail to provide hygienic

conditions of living. They worry, ruin their digestion, use stimulants and narcotics, neglect exercise, become constipated or infested with germs, lack fresh air and sufficient sleep, cramp themselves at a desk — and then think they overwork. They could do a great deal more work and carry it off well if they took proper care of their health. Our greatest workers have been men of good health.

If one has an unusually heavy job ahead of him he should set aside a reasonable time for sleep in fresh air, an hour or so for vigorous exercise in the open, provide nourishing meals — and then tackle his work with no fear of overdoing. Men doing heavy physical work are really worn out in brain and muscle by their toil if they drive themselves too hard, just as horses are, but mental workers rarely.

Yet the latter have great need of caution in this high-strung nervous age, when every force of society seems to push and pull and urge them to a faster pace. Their caution should be, however, not so much to limit their work as to increase the care of their health. The chief reason they neglect their health under the stress of work is that they lack a proper judgment of values. Work is a means to ends. It provides us with things we need for our development into better men and women. If we keep before us an adequate ideal of man and of woman, a well-poised mind, and a perfectly functioning body, we shall be less tempted to abuse the end in our concern for the means.

What is the chief reason why mental workers break down? If one has an unusually hard job ahead what care should he take to meet the strain? If you have an examination coming should you sit up till twelve or one o'clock preparing for it, or should you go to bed early? If you have two examinations in one day should you play tennis between them, or go to the library and study for the second? What kind of work puts a man in the discard in middle life? What caution is needed especially by those who do hard mental work? How can a proper valuation of the spiritual factors of life help one carry his work better?

CHAPTER XIII

EYES AND EARS

The ear is the avenue to the heart.

— VOLTAIRE.

The eyes and ears are the most important sentries of the body, which bring us most of the information of the world about us. They need especial care, and therefore have a chapter to themselves.

The Eye

Like a Camera. — In its working the eye resembles a camera in many ways. At the front of a camera is a lens, which receives the rays of light from the object to be photographed and bends these rays so that they meet in a small image on a plate or film at the back of the camera box. If the object to be photographed is close at hand, it appears larger and the rays of light from it come widespread to the lens. These widespread rays are bent by the lens to form an image far back of the lens.

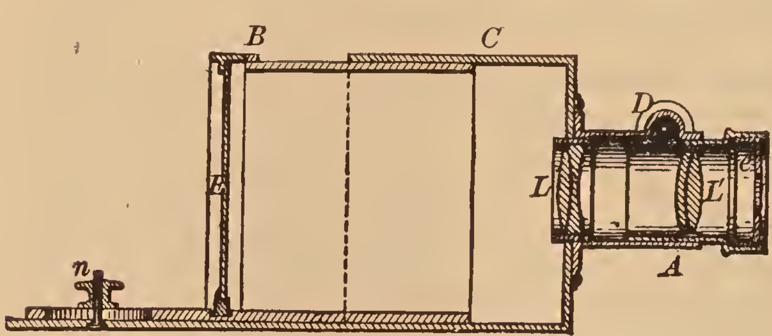


FIGURE 101. — DIAGRAM OF A CAMERA.

B – C is the box; *E* is the plate or film; *L – L*, the lens; *D*, the diaphragm.

If the object to be photographed is far away, it appears smaller and the rays of light from it are more nearly parallel.

These rays are bent to form an image at a shorter distance back of the lens. When the plate or film to receive the picture is at the right distance behind the lens to receive the image, the camera is said to be in *focus*. Thus the lens is moved farther away from the plate or nearer to it, according to the distance of the object to be pictured.

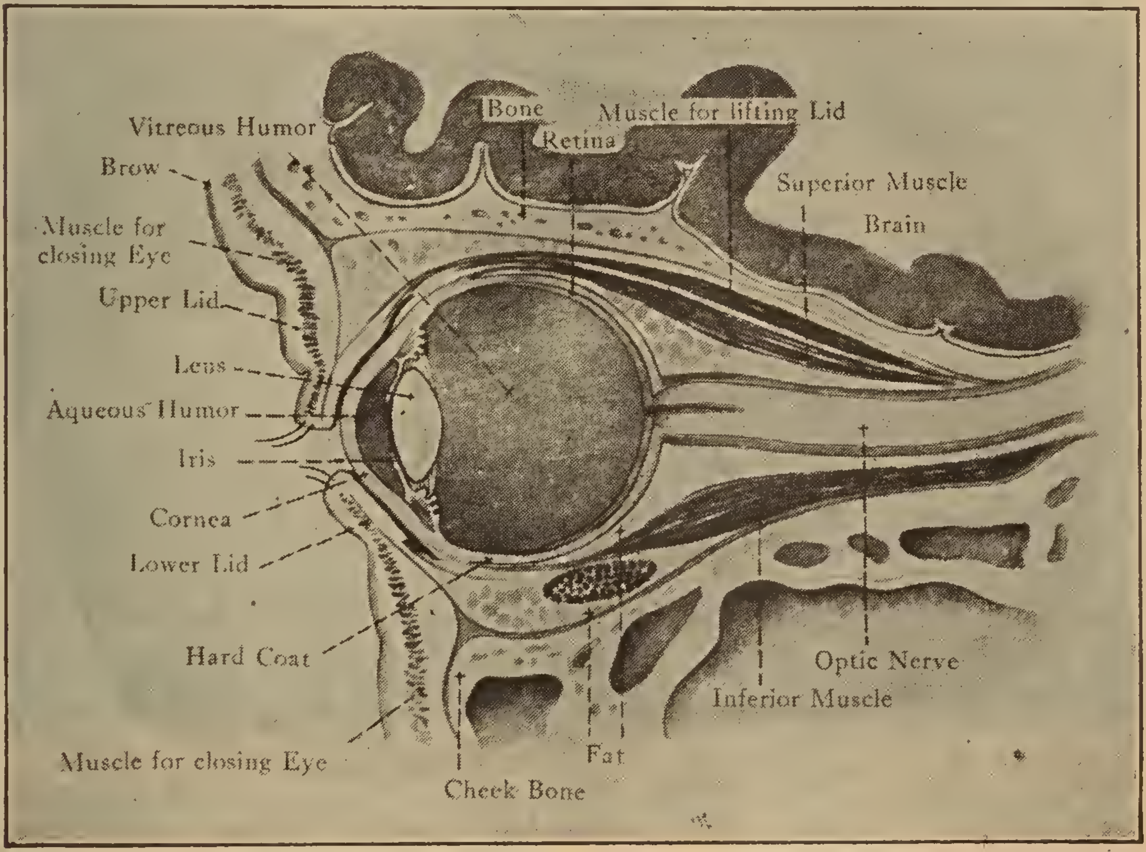


FIGURE 102. — THE EYE IN ITS SOCKET.

1. Where is the muscle situated which lifts the upper lid?
2. Where are the muscles situated which turn the eyeball up (superior) or down (inferior)?
3. What kind of tissue is packed around and behind the eyeball?
4. From what part of the eye does the optic nerve extend?
5. Name in order the transparent substances of the eye through which the light goes from between the lids to the retina.

The light that enters the camera fixes the image on the sensitive plate or film. If too little light enters, it will not act to form a clear image on the plate. If too much light enters, it will act too strongly on the plate and spoil the picture. For this reason the camera has a diaphragm just

behind or just in front of the lens with which to regulate the size of the opening to admit light.

Structure and Action of the Eye. — In the eye, the cornea and lens together act like the lens of the camera to bring the rays to a focus on the retina. The retina corresponds to

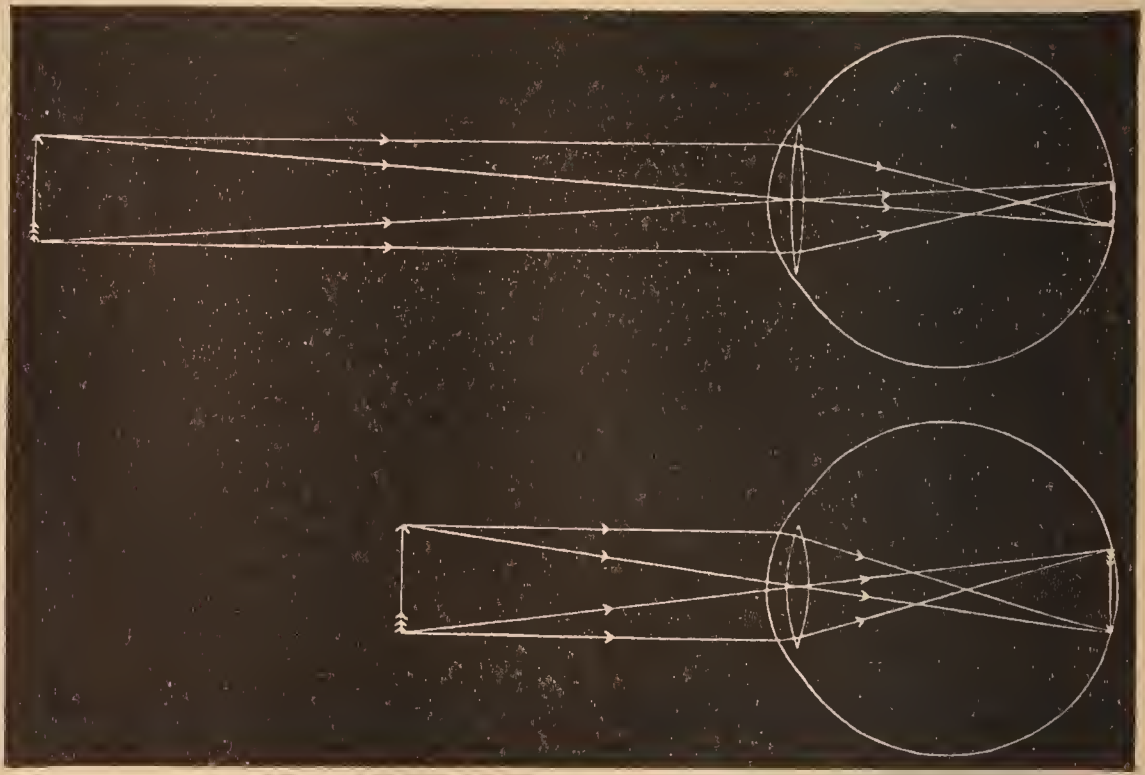


FIGURE 103. — CHANGING THE FOCUS.

The upper figure shows the rays of light from a distant object brought to focus on the retina. In the lower figure the object is nearer and therefore the rays diverge more. To bring the rays to a focus on the retina the lens becomes more convex. This work is done by the contraction of the tiny ciliary muscles around the rim of the lens.

the camera plate. The eyeball can not lengthen and shorten like the camera in focusing. But the same thing is accomplished by changes in the shape of the lens. It is elastic and can be made more or less curved by a set of tiny muscles around its margin. When we look at an object near by, these muscles contract and make the lens thicker. When we look at a distant object, the muscles relax and the lens flattens.

The *i'ris*, corresponding to the diaphragm of the camera, is a dark curtain through which an opening, the *pupil*, ad-

mits the light. Muscles in the iris regulate the size of the pupil, making it smaller when the light is bright and larger when the light is faint. The retina contains the end of the optic nerve. When rays of light form an image on the retina, nerve currents are sent to the brain — and we see.

What is the use of the lens in a camera? Explain what is meant by focusing a camera. How is the amount of light that enters a camera regulated? In what respects is the eye like a camera? In what important respect does it work differently? Why does it tire one more to look at objects two feet away than at objects in the distance? What causes us to see?

Adjustment to Light. — The eye is able to adjust itself only imperfectly to the quantity of light which enters. On a bright day or when the clear sun is reflected from snow or water, the iris is not able to shut out the intense rays; we squint and bring the lids close together to help. Even then the light seems almost painful and dazzles us. People in the polar regions or those climbing high mountains, where the sun is very bright and is reflected from a snow surface, wear amber goggles to protect their eyes. If they omit this precaution they are likely to become blind for a few days and suffer excruciating pain.

In a faint light the pupil of the eye must open wide to admit light sufficient to start a nerve current in the retina. If we try to read or do fine work when the light is inadequate we strain and tire the eyes. We should always choose *steady light of medium intensity.* A diffused light from nearly overhead is good.

For writing, the light should come from the left side in preference to the right, to avoid the shadow of the hand and pen.

In reading always observe the following precautions: 1. Have a steady light bright enough to enable you to see clearly what you are looking at, yet not so bright as to dazzle. 2. Have the light above or at the side so that it does

not shine in the face or reflect from the book to the eyes. 3. Hold the book steady at a distance of from twelve to twenty inches from the face. 4. Keep the page nearly perpendicular to the line from the eyes. 5. Rest the eyes every few minutes, by closing the lids or by looking up from the page.

Give an illustration of the eye's inability to control adequately the quantity of light which enters it. How can we artificially compensate for this imperfection? What is snow-blindness? How are we likely to injure the eyes in insufficient light? Why does a north window give a better light for reading or working than a south window? Why should one not face the light when reading or working? Which is better for lighting the room, low windows or high windows? Side windows or skylight? Would your desk be as well lighted if it faced in the opposite direction? Give the reasons.

Give five cautions to be observed in reading. Why is reading on a car an unusual strain on the eyes? Which of the four cautions are you likely to violate by reading while lying down?

Astig′matism. — Although you are filled with amazement when you consider how wonderfully the eye is adapted to take care of itself and do its work, you nevertheless recognize the fact that as an optical instrument it is not perfect. A defect from which the eyes of many people suffer is *astigmatism.* That means, the cornea or lens has such an imperfect curve that the rays of light coming through are not all exactly focused on the retina. While some rays are focused and give a clear image, rays coming through another part of the lens do not focus but give a blurred image.

An ingenious teacher has suggested the following method of testing the eyes for astigmatism: Look at the face of a watch or clock. If all the hour figures are equally clear, you are free from astigmatism. If some are clear while others are blurred, your eyes are astigmatic. Each eye should be tested separately. Keep both eyes open, but hold a card before one while you test the other. If you are near-sighted

or far-sighted you would not be able to distinguish the astigmatism from the other defect. In such case, the test is of little practical value.

If your eyes are sufficiently astigmatic to interfere with fair vision, or to give you discomfort or headache, you should go to an oculist and have them carefully examined to see just what the trouble is and what should be done for it. If

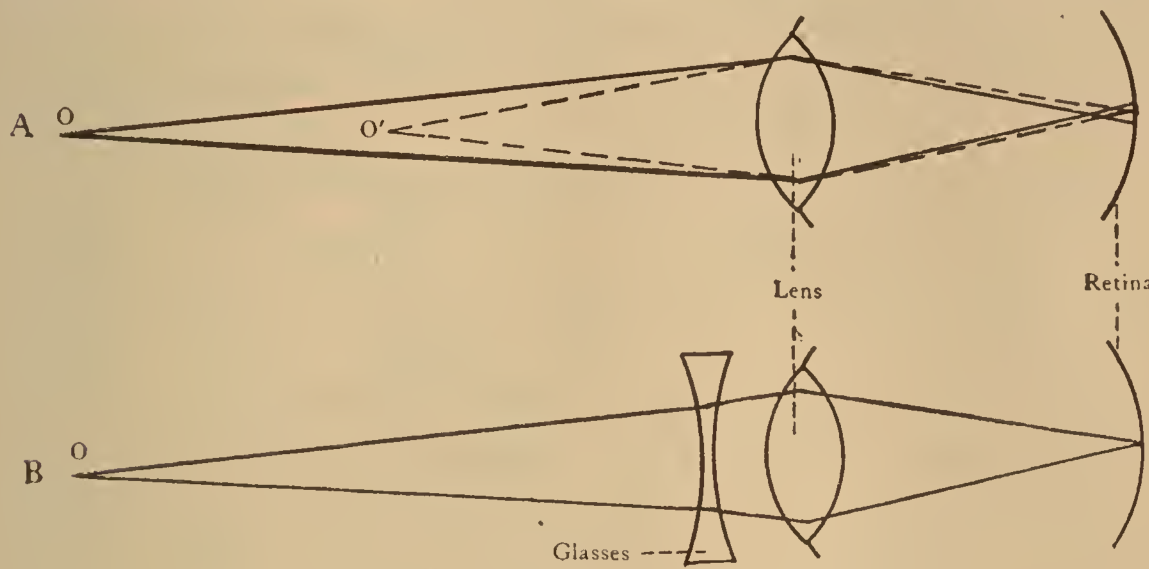


FIGURE 104. — NEAR-SIGHTED VISION.

A. Rays from object *O* focus before they reach the retina. From *O′* the rays would focus on the retina.

B. The glasses cause the rays from *O* to spread as though they came from *O′* and thus they focus on the retina.

the doctor gives you a prescription for glasses take it to an optician and have the glasses made, and then *wear them.* Don't try on several pairs of glasses at some cheap store and then buy the pair that seems to fit you best. They will probably not be well adapted to your needs, and may injure your eyes.

What is meant by astigmatism? How can you detect it? How may a bad case affect a person otherwise than by impairing vision? What should be done if vision is imperfect? What is an oculist? What is an optician? Why not select your glasses at a department store by trying them on?

Defects of Focus. — If the lens and its distance from the back of the eye were perfectly adjusted to each other, the

lens would always be able to focus the light on the retina and we should have good vision for objects at all distances. But this adjustment is frequently defective so that we are unable to see clearly. In near-sightedness, objects beyond a short distance are not clearly visible; and in far-sightedness, objects close to us can not be readily seen. There are all stages of these defects. To some near-sighted eyes every-

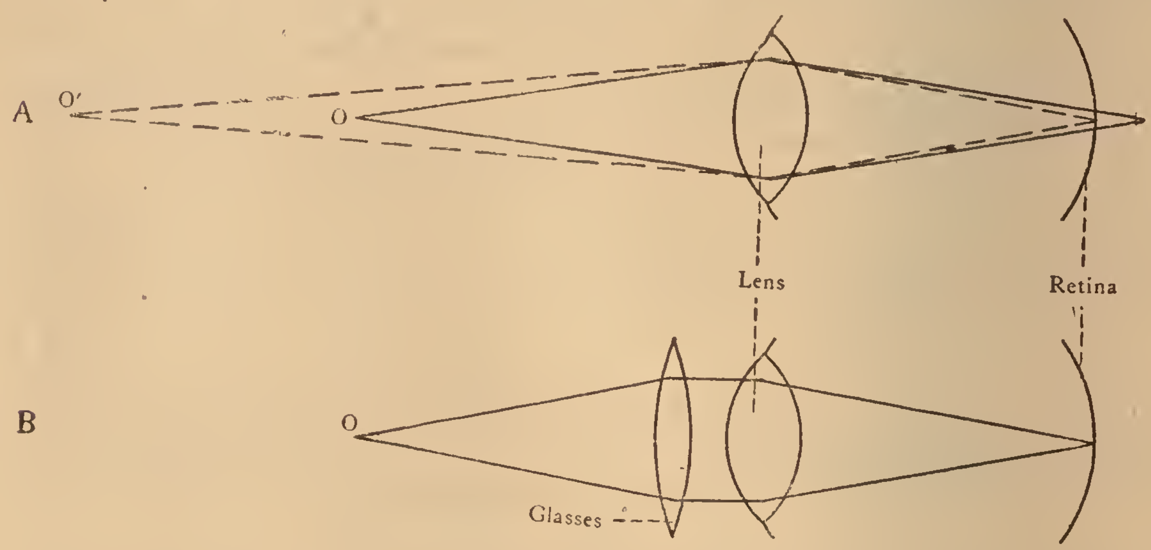


FIGURE 105. — FAR-SIGHTED VISION.

A. Rays from *O* focus behind the retina. From *O′* the rays would focus on the retina.

B. The glasses cause the rays from *O* to bend as though they came from O′ and thus they focus on the retina.

thing beyond three or four inches from the eye is blurred. Other near-sighted eyes can see well things within reach of the hand, but do not see clearly small things across the room. Far-sighted eyes can not see to read a book held in the hand, but can focus perfectly on objects across the room and farther away.

In near-sighted vision the rays of light from an object are brought to a focus before they reach the retina, so that when they strike the retina they have passed the point of focusing and have spread out again so as to blur the image. To correct this fault concave glasses, thick at the rim and thin in the middle, are worn. They spread the rays entering the

eye and cause the lens of the eye to form the image back far enough to fall directly on the retina.

In far-sight the focus is behind the retina, since the lens is not curved enough for the length of the eye. Convex glasses, thick in the middle and thin at the rim, are worn to make the rays entering the eye spread less and so bring the focus nearer. When the oculist tests the eyes he commonly finds astigmatism associated with near-sightedness or far-sightedness and has one pair of glasses made to correct both defects.

If you have difficulty in reading across the room what is written on the blackboard, or in reading your book held at arm's length, you should suspect you are near-sighted and should consult an oculist. Far-sight is not so easily recognized. If it tires you or makes your head ache to read, or if you can read more easily a book at arm's length than at fifteen inches from your eyes you should suspect your eyes are far-sighted and need the doctor's attention. It is not possible for you to find out by yourself just what is the matter with your eyes. If you suspect that something is wrong with them you should go to an oculist and have him make the test. Then you should follow his directions in taking care of them.

What condition of the eye is the cause of near-sightedness? of far-sightedness? What symptoms should make one suspect that he is near-sighted? What would make one think he is far-sighted? In either case what should be done? How do near-sight glasses differ from far-sight glasses?

Disease Germs in the Eye. — Germs which produce pus are common on our skin and in dust. They frequently get into the eye and grow, producing "matter" which interferes a little with our clear vision and collects in the corners of the eye, especially the inner corner. We rub it out as thick liquid or dried grains. In the morning the lids are sometimes stuck shut by the dried pus. We should keep

the pus germs out as much as possible. Avoid rubbing the eyes with the fingers. When the eyes contain pus they should be washed out with boric acid, which should be applied with a clean dropper or absorbent cotton.

Babies at birth may have germs in their eyes that will penetrate the eyeball, making it sore and destroying sight. If the doctor washes the eyes immediately with a strong antiseptic, usually silver nitrate, he can kill the germs and save the eyes. A large per cent of the blind people owe their blindness to neglect at birth. At the least sign of pus in a baby's eyes the doctor should be called to treat it.

Tracho'ma (granular lids) is a disease which causes a great deal of blindness in some countries. It has quite a foothold in some of our southern states. A case in the early stage can usually be quickly cured. Ignorant and poor people are likely to neglect it and go blind.

A *sty* is a pustule, like a pimple on the face, in an oil gland of the eyelid. It should be opened, the pus wiped off and destroyed, and the eye washed with boric acid.

What can we do to keep pus germs out of the eyes? How can we notice pus in the eye? What should we do to get it out? What is the common cause of blindness in babies? What should be done to prevent it? What germ produces a great deal of blindness in some localities? What should be done with a sty?

Care of the Eye. — One of the things we should all learn to do for the eye is to remove a grain of dust, or a cinder, carefully. Nature provides tears, secreted by a gland within the socket and above the eye near the outer corner, for washing over the surface of the eye and carrying away the dust. The tears, flowing across the eye, drain into the nose through a little tube opening near the inner corner of the eye, and roll over the cheek only when produced too rapidly for the tube's capacity. If a gritty particle will not wash out it must be wiped off or picked out. A piece of clean absorbent cotton is best for wiping the eye. If the

intruder is under the lower lid, put your finger on the cheek bone near the eye and pull the lid down. Wipe the cotton gently over the eyeball and inner surface of the lid.

The cinder is usually under the upper lid. With the thumb and finger seize the lashes and pull the lid out a little, while with the side of a pencil or match you press down on the back part of the lid. This turns it inside out and enables you to wipe the eyeball and lid with cotton. If the cinder does not come, it probably has a sharp edge which is driven into the tissue, and the doctor must remove it. While waiting for the physician keep the eye still and protect it with a loose pad or bandage. *Do not rub it!*

If the eyes become red and painful from too much use or from germ infection or from any other cause, it is wise to consult a doctor. You will be able to relieve the pain and congestion by lying down, closing the eyes and placing on them gently a wet cloth as hot as can be borne. Wring out the cloth every few minutes in hot water to keep it hot.

How does nature remove dust from the eye? Why does most of the dust collect at the inner angle of the eye? How would you remove a particle from under the lower lid? How from under the upper lid? How can you relieve congestion and pain in the eyes?

The Ear

The external part of the ear acts somewhat as a funnel to catch the vibrations of the air and direct them into the canal. At the end of the canal is the *drum membrane*, which is set in motion by the air vibrations. The vibrations of the drum membrane are communicated by a chain of three tiny bones across the air space of the middle ear to the internal ear. This is a chamber, part of which is in the form of a snail shell, filled with a watery fluid in which are the ends of the auditory nerve fibers. When the fluid of the snail shell is set in vibration the auditory nerve fibers carry

nerve currents to the brain, — and we hear that which started the vibration of the air.

There is very little attention to be given the ear compared with the eye. We do not abuse it by using it too much or in faulty ways. We rarely damage it by thrusting objects in to clean it. Yet the rule never to pick the ear with anything smaller than your finger is a good one. The lining

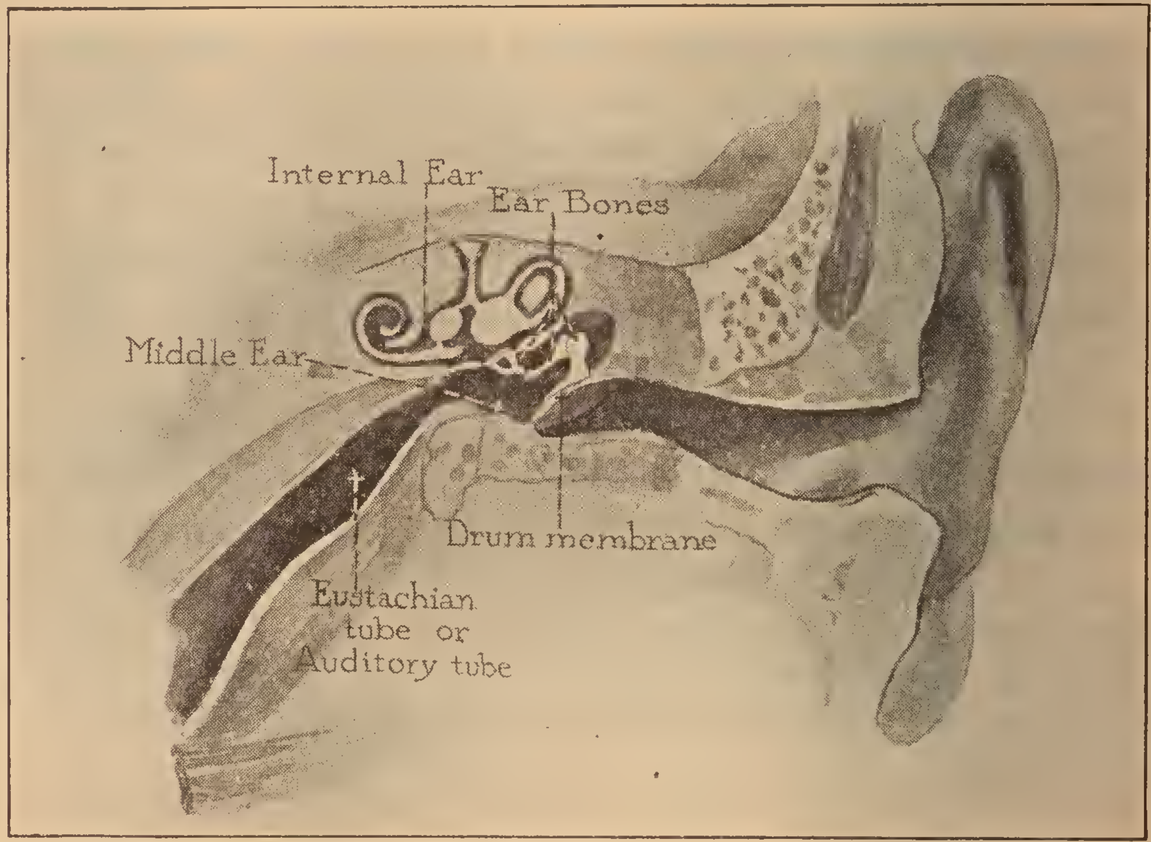


FIGURE 106. — A SECTION THROUGH THE EAR.

The auditory tube is split and spread open making it appear larger in diameter than it really is. What forms a bridge across the air space of the middle ear connecting the drum membrane with the internal ear?

membrane of the canal is easily scratched and irritated. The drum membrane may be punctured. A rag over the finger will clean the ear adequately, unless there is sufficient accumulation of wax to interfere with hearing. Then a physician should be asked to remove it.

The chief damage to the ear is done by germs which come through the (Eustachian) auditory tube. Though there

are cilia in the tube to sweep out mucus and germs, when we have a bad "cold" or influenza, measles, scarlet fever, tonsilitis or other throat infection some of the germs are likely to get up the tube to the middle ear. Here they grow and produce pus, which has difficulty in getting out of the tube because of the swollen lining membrane. The pus may break through the drum and escape by way of the outer canal, causing a running ear. This break may be harmless, or it may impair the hearing, depending on the size and position of the rupture. The doctor sometimes makes a harmless puncture through the drum membrane to let out the pus and forestall an injurious break.

The damage done by the pus in the middle ear may be slight or it may be beyond repair. The bones may be so injured that they can not transmit the vibrations, and deafness may result. The pus may penetrate from the ear to the mastoid bone behind the ear. If it drains thence to the outside, the patient recovers. If it penetrates to the brain, death may result. Any serious trouble with the ear should have the *immediate* attention of a physician. The greatest danger lies in delay.

We should do our best to avoid "colds" and all throat infections. Once we have an infection we should get rid of it as soon as possible lest it extend into the ear. The physician can do much to hasten recovery, but there is no specific cure. We have to depend on the germ-killing forces within the body and the power of the tissues to recover. The swelling and pain can be reduced by hot applications, — a hot flannel cloth, a hot water bag, an electric light held close to the ear.

A running ear should be washed only according to the physician's directions. A loosely fitting plug of cotton is kept in the ear to absorb the pus, is changed several times a day, and is destroyed when it is removed.

Water in the ear does damage if it gets through a hole in

the drum membrane. It is well to wear rubber plugs in the ears when swimming and diving.

How should one clean the ear? Why not use the head of a pin? Through what avenue is the ear commonly attacked? What is a running ear? Name several ways in which germs in the ear may do serious damage. How is mastoiditis produced? Why does the surgeon advise operation? How can we reduce the pain of earache? Why should the cotton plug from a running ear be burned or otherwise destroyed? Why is it advisable to wear rubber plugs in the ears when swimming?

CHAPTER XIV

SOME COMMUNICABLE DISEASES

Against diseases here the strongest fence
Is that defensive virtue, abstinence.

— HERRICK.

A great bacteriologist has said: "We never really cure any disease; we only help the body to overcome it." There seem to be some exceptions to this statement. There are chemicals, such as quinin for malaria, which are specific remedies for certain diseases. Yet in most cases the body's own activity works the cure.

Recovery from bacterial disease, such as diphtheria, results from one or both of the following things that occur in the body: 1, White corpuscles destroy the hostile bacteria; 2, *anti*-substances formed by the cells, act *against* the invading germs or counteract their poisons. These anti-substances, called *anti-bodies*, accumulate in the plasm of the blood and so are carried to all parts of the body. Although we can not show the presence of these anti-bodies by microscopic examination or by chemical tests we know of their presence by their observed results. Some of them destroy the bacteria outright — cause them to disappear utterly. Others increase the activity and germ-killing power of the white corpuscles. The antitoxins are anti-substances which neutralize the toxins or poisonous products of germ activity.

Immunity from a disease by which we have been attacked is due to the fact that these anti-bodies persist in the body after the germs of the disease have been destroyed. They

persist for a very long time after an attack of smallpox and certain other diseases. In case of an ordinary "cold," the anti-bodies disappear in a very short time after the "cold" has been cured.

Knowledge of these facts has enabled scientists to make great progress toward the brevention or cure of certain diseases. We should all understand what the ordinary citizen can do to aid in the crusade against preventable diseases, in order that we may take the best care of our own health and help most intelligently in conserving the health of the community.

Smallpox. — For centuries smallpox was the scourge of the world. At intervals it would sweep over a nation killing tens of thousands of people and leaving more thousands pock-marked for life. As late as the last half of the 18th century, less than ten people in every hundred in England, France, and Italy escaped the scourge. One in every seven who contracted the disease died of it, and many of the survivors were left blind or deaf. The disease killed 60 million people in Europe in the 18th century.

Now its ravages have been thoroughly checked in the enlightened parts of the world, though ignorant peoples still suffer severely from it. The two chief factors which have freed us from the dread of this loathsome plague are *quarantine* and *vaccination.*

Nearly everyone recognizes the desirability of keeping a patient that has any communicable disease away from other people. Yet quarantine, even though it is supplemented by the most strict measures of sanitation, is utterly inadequate to stem the sweep of this terrible scourge. Vaccination, when thoroughly practiced, does altogether check it. The reason why there are always a few cases of smallpox in a large community is that not all people are vaccinated. When everyone is vaccinated, the disease will be stamped out and there will be no need of subsequent vaccination.

A single vaccination does not insure one for life. But if one is vaccinated when three or four years old (the time a child begins to run about and expose itself to contagion), again at twelve to fifteen years, and again in the twenties, one is practically sure never to have smallpox. Yet if a person is likely to be exposed to the disease at any time, he would do well to be re-vaccinated. Those who fall victims to the disease are the people who have never been successfully vaccinated, or whose vaccination is old. A person who has been successfully vaccinated at the intervals indicated above seldom takes the disease, or if he does

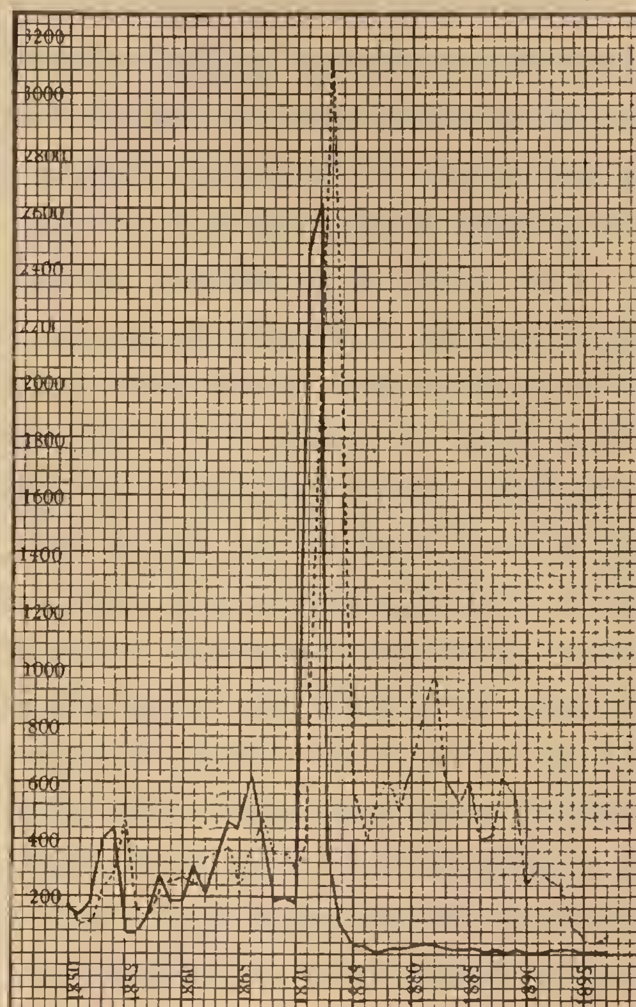


FIGURE 107.

VACCINATION PROTECTS.

The graphs in Figure 107 indicate the number of people who died of smallpox for each million of the population — the continuous line in Prussia, the dotted line in Austria. An epidemic of smallpox swept Prussia in 1871 and 1872, and Austria in 1872 to 1874. Both countries maintained the practice of vaccinating infants, which protected the young children and left only the older children and adults susceptible to the disease. In 1874 Prussia passed a law compelling all children of 12 years to be re-vaccinated. This almost at once reduced her smallpox deaths to a negligible number, while in Austria, where re-vaccination was not compulsory, the deaths from smallpox continued numerous. Vaccination protects from smallpox but not for life. There should be a second vaccination at the age of 12 or 14 and a third at the age of 20 or 30.

take it, he has a very light attack. He does not die of it.

It was the observation of dairy workers in England in the 18th century that people who had contracted cowpox, while milking cows, were immune from smallpox. Edward Jenner, a physician of Berkeley, England, made tests which proved the truth of this belief, and thus introduced vaccination.

The virus with which we are vaccinated is obtained by vaccinating a healthy young cow with smallpox germs. The germs are weakened by growing in the cow's body. The virus is taken from the vaccination spot in the cow's skin and scratched into the skin of a person. The germs grow and produce in the person the disease of cowpox, identical with smallpox but very much milder. The body produces anti-bodies which counteract the disease and which persist to guard the body against smallpox for years after. If the virus is not fresh, the germs in it are likely to be dead and it will not take. In case vaccination fails, therefore, a second, or even a third attempt is advisable. If several attempts with fresh virus fail, the body is probably temporarily immune to the disease.

Whether to be vaccinated or not is no longer a question for debate. The danger from careful vaccination by a physician is so small that it need hardly be taken into account. Only virus from a healthy cow is used. The utmost care is taken to keep the virus free from harmful germs and to keep the spot on the skin free from contamination while it is fresh. It is only when such precautions are neglected that any trouble follows. The fact that millions of men in the army and navy have been vaccinated without a single disaster shows how safely the operation can be done. The evidence that vaccination does afford protection is so overwhelming that only those who do not know the facts or those whose prejudice is so great that they refuse to see the facts, object to the operation.

There is little danger to-day from smallpox, but this condition is owing to the widespread practice of vaccination. Yet we may be exposed to a case any day in street cars or public gatherings. Some people argue that since there is little danger, they do not care to incur the slightest inconvenience. This is the selfish argument of one who is willing to profit by the service of others but who is unwilling to contribute anything to the common good.

How does the body overcome disease? In what various ways do anti-bodies act? How does the body attain immunity against certain diseases. Name several countries in which you think there would naturally be little smallpox and others where you think it is probably common? How serious trouble did it give before vaccination was discovered and generally practiced? How has it been checked? How often should an individual be vaccinated? How was vaccination discovered? How is it practiced? What care must be used? What is the result of vaccination? Why should everyone be vaccinated?

Typhoid Fever. — Typhoid fever is another disease which can be thoroughly prevented by a means recently devised. We tried for many years to prevent the spread of typhoid by sanitary means only, and succeeded in considerably reducing the number of cases.

The germs grow in the intestine and are consequently discharged chiefly from the bowels. The sewers become contaminated, and from them drinking water is often polluted. Years of terrible experience taught us to take care of our water supply. Then we discovered that flies got the germs on their feet if they were allowed access to the sewage and brought the contamination to our food. So we learned to take better care of the sewage and to fight the flies.

Now we find that many typhoid patients are not free from the germs when they get well. The germs get into the gall bladder or other nook and live for months or years, every day sending a delegation down the intestinal tract to spread the disease to others. Such a person is called a "carrier."

He should take unusual pains to prevent the spread of the germs and should never handle the food of other people.

Such sanitary precautions should never be relaxed, but they can not be perfect. Any of us may at any time get the germs into our intestines and succumb to the disease. There is, however, a sure prevention, proved by millions of treatments with almost no failures. It rests on the principle that dead germs injected into the body cause the body to build up its defenses against live germs of the same kind. This principle does not apply equally to all kinds of germs, but is wonderfully exemplified in the case of typhoid.

(By permission of the Chicago *Record-Herald*)

FIGURE 108. — SWAT THE FLY.

Kill the flies in the spring. The progeny of a single pair might in one season under favorable circumstances amount to 350,000,000. The common house fly has so often carried the germs of typhoid fever that it has been called the typhoid fly.

The germs of typhoid are isolated and cultivated in the laboratory. They are then killed by heat and the dead germs are injected under the skin. Fifty or a hundred million or more are used in a dose. Three injections are made a few days apart. The recipient of the treatment is sometimes made slightly ill by it, but not so as to interfere with his work. Commonly he does not notice much effect at all. The treatment pretty thoroughly protects one from typhoid for several years — just how long is not known.

There is a disease similar to typhoid called *para-typhoid*,

produced by a different germ. After being protected against typhoid one may have para-typhoid, which some doctors may not distinguish from typhoid. Therefore the protective treatment may have *seemed* to fail. In recent preventive injections both kinds of dead germs are used at once so the protection is complete for these two diseases. In olden wars, typhoid was more deadly than all the contraptions of battle. In the recent Great War, typhoid was practically unknown in the armies in which the preventive treatments were given to the soldiers. It is used throughout our army and navy, in time of peace as well as in war. People traveling or likely to get contaminated food or water always do well to take it.

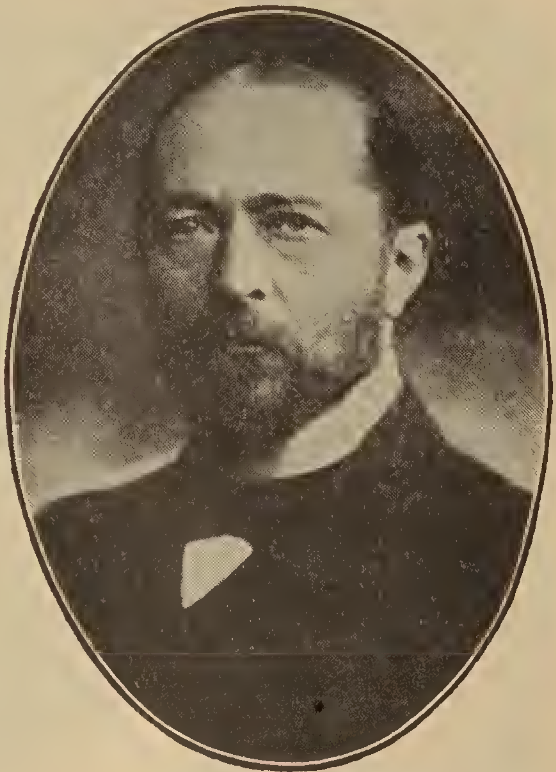


FIGURE 109. — EMIL ADOLPH BEHRING, born 1854.

He discovered diphtheria antitoxin, which saves the lives of thousands of children every year.

Where do typhoid germs grow? How does drinking water become contaminated with them? Name several things we do at great expense to protect the water supply. What other factors spread typhoid? Have sanitary precautions decreased typhoid? Have they eliminated the disease?

What treatment will prevent typhoid? How does the treatment prevent? In what way are the recent treatments better than the earlier? Who should take the anti-typhoid treatments?

Diphtheria. — Only a few years ago diphtheria (sometimes called membranous croup) was very severe in its attacks. We were filled with consternation when it broke out in our community, and we could only sit helpless and watch the children die. Now we know just what to do for it. We can cure the sick and prevent others from taking the disease.

The reason it is not altogether stamped out is because we do not provide our health officers with sufficient means, and because the people are too ignorant and careless to give them adequate support. Everyone should share in the campaign. Therefore we must teach everyone what to do.

FIGURE 110. — ANTITOXIN PRODUCTION.

The first step in the production of diphtheria antitoxin is to grow the diphtheria germs in the laboratory. The glass flasks in this illustration contain serum, a food for the germs. The operator is introducing pure cultures of the bacteria. The toxin produced by the growth of these germs will be injected into a horse.

When we have diphtheria the cells of our body do the best they can to protect themselves. The germs growing in the throat produce a toxin which is absorbed and carried through the body, poisoning it. Our cells produce an antitoxin to counteract this toxin, and if they produce enough, we get well. The germs are probably killed off by our white blood cells. If our cells produce too little antitoxin, the toxin of the disease poisons the nerve centers and the heart stops beating. The curative treatment consists in bringing in antitoxin to help out that which our cells produce.

The antitoxin is obtained as follows: Diphtheria germs taken from the throat are grown in the laboratory, where they produce their toxin. This toxin (no live germs) is injected under the skin of a healthy horse. His body produces antitoxin to counteract this poison. After a few days the

horse is given a larger dose of the toxin, and his body produces more antitoxin. This is kept up for many weeks with increasing doses until the horse's blood is well loaded with antitoxin. Then the horse is bled and from his blood the serum containing the antitoxin is extracted.

FIGURE 111. — ANTITOXIN.

Diphtheria antitoxin is packed in aseptic tubes in the laboratory. The doctor administering the dose attaches the needle and piston handle to this tube and so makes it a hypodermic syringe. By this method the antitoxin is kept from contaminating germs.

The antitoxin taken from the horse is injected into the body of a person sick of diphtheria. If this is done promptly, *the first day the disease appears*, the patient is well in two or three days. If the treatment is delayed two or three days the patient's recovery is slower and less certain. After the fourth or fifth day, the treatment is not likely to succeed. Of course with the treatment should go careful nursing and the patient should be quarantined. But it is mainly the antitoxin that produces the magical cure and prevents the spread of the disease.

The stories about the injuries produced by the injection of antitoxin are mostly false alarms. When the antitoxin was first used there were some bad results. But since the improved methods have been employed there is little to fear. The severe

illness and death which sometimes follows the use of antitoxin is owing to the toxin of the disease, and the tardy administering of antitoxin.

To check the spread of diphtheria every case of severe sore throat should be quarantined and watched very carefully for a day or two. A culture should be made. If it proves not to be diphtheria no harm has been done, and the patient is probably better for the care received. If it is diphtheria the patient and all those who have been exposed to him should immediately receive the antitoxin, because antitoxin is a preventive as well as a cure. The patient is kept in quarantine until repeated examinations of the throat fail to show any diphtheria germs.

Much diphtheria is spread by "carriers," people who feel well and go about their daily work, yet have live diphtheria germs in the throat. It would be a heavy task to examine carefully the throats of all school children and quarantine the carriers till they are free from the germs, but nothing else is an adequate means of completely stamping out the disease. Adults as well as children may be carriers. Removal of the tonsils often frees such carriers from the germs.

Recently a test (Schick test) has been devised by which it is possible to tell whether one is susceptible or immune to diphtheria. It is found that about half the people could take the disease if they were exposed; the other half could not. If the susceptible people were all given a preventive treatment there would be no fertile ground for the disease and it would disappear. The preventive treatment consists in injecting "TA," a mixture of toxin and antitoxin. It gradually prepares the body to resist the disease. Three or four months after the treatment the body is fortified and will remain protected for several years.

What change in our attitude toward diphtheria has come within the last thirty years? What is the cause of this change? Why have we not driven diphtheria out of the country?

How does diphtheria harm us? What does the body do in self-protection? What can we do to assist the body? Describe the process of producing commercial antitoxin. Discuss the importance of early use of antitoxin for prevention as well as for effecting a cure of diphtheria. What should be done with a child the first day it has a severe sore throat?

What is a diphtheria carrier? How should he be treated? Why should throat examinations be made of all school children?

What is the purpose of the Schick test? What is "TA"? For what is it used?

Tetanus. — Tet′anus (lockjaw) is mentioned here because it kills a good many people though it can be cured in just the same way as diphtheria is cured, by an antitoxin. We can not hope to get rid of tetanus, the germs are so broadcast. They grow in the intestines of some domestic animals; they infest stables and pastures. *They do not grow in clean open cuts*, but in deep wounds or under the skin, away from the air. Wounded soldiers brought back from the front in cars which had been used in transporting horses were infected with the disease. The trifling injuries produced by small fireworks often develop tetanus. Punctures by rusty nails are thought by some people to be especially dangerous. The rust is harmless. The danger lies in the likelihood of tetanus germs being on the nail or on the skin.

To prepare tetanus antitoxin, tetanus germs are cultivated in the laboratory and the resulting toxin injected into a horse, — just the same process as for diphtheria. The tetanus antitoxin is of little value unless it is used early. If it is used immediately after the infection it almost always prevents the development of the disease. If its use is delayed until the disease has set in it is often too late.

Why will tetanus always be a problem of the treatment of the injured and not of the extermination of the germs of infection? Where do tetanus germs grow outside the body? How do they get into the human body? How is the disease cured? Why is early treatment important?

Rabies or Hydrophobia. The treatment for the prevention of rā′bi-ēs, like vaccination against smallpox, consists in causing the body to build up resistance against the infection by the production of anti-bodies. Pasteur made the great discovery not only that all infection is caused by germs, but that each kind of infection or disease is caused by its own peculiar germ. With these facts established, he set about to find methods of fighting some of the most deadly germs.

Rabies is generally caused in men by the bites of rabid animals, and affects particularly the nerve system. It is not strange, therefore, that the spinal cord of a rabid animal should contain the germs of the disease in their most virulent form. Pasteur found that if the spinal cord of a rabid animal is dried, the germs of rabies become weaker. The longer the drying process, the weaker the germs become.

The preventive treatment consists in injecting into the body of a person who has been bitten by a mad animal a preparation made from the dried spinal cord of a rabid animal — generally a rabbit. As the body builds up resistance against these weakened germs, stronger and stronger injections of spinal cord material (dried for shorter periods of time) are administered. In about three weeks, immunity is established in the patient. Fortunately, rabies does not develop until from three weeks to six months after infection. This always allows sufficient time for treatment, *if it is begun promptly.*

How is rabies prevented? Why is prompt treatment necessary?

Tuberculosis. — Tuberculosis is largely an economic problem. Although it attacks people in all walks of life the poor are preëminently the sufferers. There is little chance of freeing the community from tuberculosis until we get rid of poverty. It attacks the poor because they exhaust themselves with work, are ill nourished, and lack fresh air. The well-to-do are less often affected. They live in ways that

prevent the disease; they have plenty of good food, fresh air, sunlight, rest.

Those who work in a dusty atmosphere or in cramped positions are the worst sufferers. There was a terrible increase of tuberculosis in the European countries during the War. It attacked the exhausted soldiers in the trenches. It made greater inroads among the ill fed and poorly housed at home. It is still rampant and will continue its ravages until the extreme poverty arising out of the War is mitigated. In most cases rest, fresh air, and good food will cure tuberculosis. A preparation of dead tuberculosis germs is used with good effect sometimes.

Though we must endure tuberculosis as long as we maintain an economic system which produces ignorance and abject poverty we can do much to limit its spread. People with open tuberculosis of the lungs, who are coughing and spitting the germs for the rest of us to take in, should be cared for in sanitaria. Many of them could be cured and returned to useful occupations. They could all be trained to avoid spreading contagion.

If we were thoroughly rational and had the good of the whole community at heart we should provide sanitarium care for those also who are in the early stages of disease and still able to work. If they persist at their work while ill they will succumb. If they are given rest, fresh air, abundant food, and the needed medical attention, they may quickly be restored to full strength and become valuable members of society.

Many children contract tuberculosis from the milk of tuberculous cows. We make a half-hearted effort to prevent the use of tuberculous milk. But here again it is an economic problem. It would cost considerable to free our milk herds from tuberculosis. It could be done. But as long as it is some one else's children that suffer, we pay a little more for certified milk for our own children, — and let the matter

pass. We have some pure food laws. We need more. Most of all, we need officials who will be very much concerned about our health. Then we need to give them whole-hearted support. Only by so doing can we free the community from this contamination of the children's food.

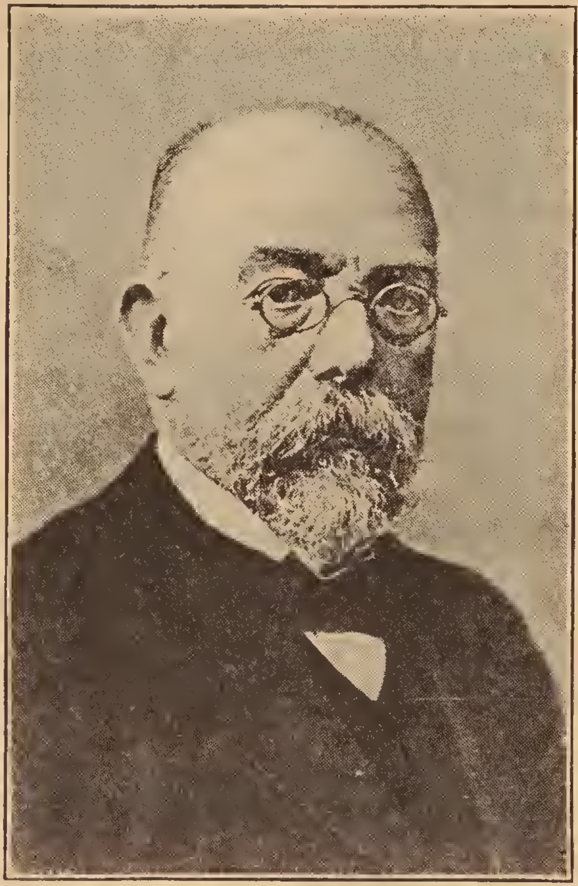


FIGURE 112. — ROBERT KOCH. 1843–1910.

He was one of the earliest and most successful students of germs which cause diseases. In 1882 he discovered the tubercle bacillus which causes consumption. He also discovered the germs which cause erysipelas, blood poisoning, and sleeping sickness, and did much to advance the treatment and cure of these diseases.

We must not forget that anyone is liable to the disease if his body is weakened. To avoid tuberculosis we should observe the general rules of health, — plenty of food but not too much, fresh air, sleep, exercise. Thus we develop strength to resist the germs when they attack us, as they pretty surely will at times. We should, however, expose ourselves as little as possible to the germs. Though we do not need to shun our tuberculous friends we should be careful to avoid unhygienic intimacies; no kissing. The tuberculous should not handle food for others. If we do contract the disease we should get from our physician full rules for our conduct. They are too extensive to be given here.

What people suffer most from tuberculosis? Why? Why are the well-to-do more likely to recover from tuberculosis? Why should people who have open tuberculosis be cared for in sanitaria? Why should people in the

early, non-infectious stages of the disease be provided with sanitarium care?

How is tuberculosis commonly spread to children? How could we protect them?

What is the best thing we can do personally to avoid getting tuberculosis? How can we avoid exposure? Why are people forbidden to spit on floors and sidewalks?

Sanitary Precautions. — The enactment, as well as the enforcement, of laws must be backed up by intelligent public opinion. Many people are brought face to face with the importance of sanitary ordinances only when sickness or death in their own families results from the failure to enforce such ordinances.

The community should exercise much more careful supervision over public concerns that handle food than it now does. Food in restaurants, delicatessen and grocery stores, that is liable to contamination by handling of patrons, or by mice or insects, should be kept under glass. Employes in such concerns should be licensed for their work. A license should not be issued except upon physical examination to prove that the individual is not a carrier of disease and upon proof that the applicant knows the fundamentals of sanitation as applied to the handling of foods.

The lack of care of dishes at the ordinary soda fountain is worse than disgusting: it is dangerous. All glasses and dishes should be washed in hot soapy water, rinsed with clear hot water, and preferably drained without wiping. Especial care should be given to spoons, knives, or forks. The safest plan is to use paper dishes, cups, and spoons, which can be destroyed without using a second time. In the best hotels and restaurants, where washing machines are used, the dishes come from the machine so hot that they dry readily without being wiped. This is as nearly perfect a system as has been contrived.

Hygienic drinking devices or individual drinking cups

should be provided at all public drinking fountains, in factories, or in other places of employment. All employers should be compelled to maintain absolutely sanitary lavatory and toilet facilities for employes. Paper towels are always to be preferred to cloth towels of doubtful cleanliness in public lavatories.

All public gathering places should be provided with effective means of ventilation. Floors should be kept clean, and something more vigorous than the mere posting of signs done to prevent spitting.

Laundries are not always as careful as they should be to keep all clean clothes absolutely out of contact with soiled clothes. Some hotels practice a doubtful kind of economy in changing only the lower sheet of each bed. Hotel sheets should be long enough to fold back over soiled blankets. The Oklahoma law demanding nine-foot sheets in hotels was not a crude joke. It was a wise provision for hotel sanitation.

Dentists', hair-dressers', and barbers' implements should be steam sterilized, boiled, or chemically disinfected after using.

The city itself could set an excellent example to the citizens in the cleanliness of its streets, alleys, and public toilets.

What could be done in public concerns that handle food to cut down the danger of disease transmission? How should dishes at soda fountains and in hotels and restaurants be cleansed? What provisions should every employer be compelled to make for the health of his employes? What can the movie theaters do to help in the campaign for health? Laundries? Hotels? Dentists, hair-dressers, and barbers?

CHAPTER XV

SAFETY FIRST

An ounce of prevention is worth a pound of cure.

— PROVERB.

The Need and the Hope. — Modern science has wrought almost miraculous cures through the skill of the surgeon and the recent discoveries in the healing art. But the greatest medical achievements lie in the realm of prevention. Prevention of disease is the goal of medical science. It is the duty of every citizen to supplement the life-saving work of the physician and the surgeon by bending every effort toward prevention in the sphere of accidents — to aid in a consistent campaign to decrease the hazards of everyday life. Hope for the ultimate success of such a campaign lies in educating people to the need of conducting it.

During the Great War 70,000 of America's fighting force were killed or died of injuries and disease. During the same months 120,000 people in the United States were killed in accidents. In the War 225,000 Americans were injured, while during the same time in the United States 3,000,000 were seriously injured in accidents. The financial loss is beyond our comprehension. That of fire alone is $300,000,000 yearly, five sixths of which is unnecessary. There is need of the gospel of "Safety First."

Most accidents could be prevented if we gave sufficient attention to the matter. In factories accidents occur most frequently when the workmen are tired. Working children especially suffer accidents when they have worked too long.

In the home and on the street accidents occur because we are careless. Children meet with injuries while seeking amusement — because we do not provide safe playgrounds for them.

Discuss the extent of loss of life, limb, and property by accidents. Explain how we may hope to remedy the evil.

National Safety Council.

FIGURE 113. — IS HE KILLED?

The children were coasting in the street. One met disaster under the wheel of an automobile. The streets are for traffic. Places for play should be provided where there is no danger from cars.

Illuminating Gas. — The two common disasters produced by gas are explosion and suffocation. Explosions come when escaped gas has mixed with the air and an open flame ignites the mixture. The caution is — never to bring a candle, lamp, or lighted match into a room or basement where there is a gas leak. One should use a flash light or find his way without a light to the meter and turn off the gas; then ventilate the room before starting to find the leak.

Accidental suffocations usually occur when persons are asleep, since if they were awake, the smell of the gas would

serve to warn them. A burner for heat or light should not be left lighted in the room when a person goes to bed, lest it go out and fill the room with gas. A rubber hose makes a dangerous connection for a gas plate or heater. The hose may crack or get loose and allow the escape of gas.

In what safe way can a person look for a gas leak? Why is it dangerous to go to sleep with lighted gas in the room? Why is a rubber hose connection for a gas heater dangerous?

Carbon Monox′id. — One of the constituents of illuminating gas is a poisonous gas, carbon monoxid. It injures the one who breathes it not only by displacing oxygen in the lungs, but also by destroying the red corpuscles of the blood with which it comes in contact. Carbon monoxid is produced by incomplete combustion when fuel is burned without sufficient oxygen. It forms in heating stoves containing an excess of coal and burning with the draft closed, and is likely to escape into the room if the damper is shut. To avoid it, put on the fire only a little coal at a time and supply air enough for complete oxidation. Gas engines often generate it. We frequently hear of men's dying suddenly in closed garages. Such persons are commonly poisoned by the carbon monoxid from the engine. *The engine should not be run when the garage is closed.*

How does carbon monoxid injure the body? How can we avoid it in the room? How avoid it in the garage?

Fire. — The five chief causes of destructive fires are:

1. *Electricity.* The trouble is generally defective wiring. Most cities have ordinances specifying how wiring must be done and provide inspectors to see that the rules are observed. When the work is done according to modern specifications it is practically safe.

2. *Matches.* Smokers are responsible for more than half the damage done by matches. They should always see that the match is entirely extinguished before it is thrown down.

Children often burn themselves fatally and destroy homes by playing with matches. Rats sometimes use matches in building their nests and so cause destructive fires. If safety matches only were used, as the law requires generally in Europe, there would be less damage from them. All matches should be kept in metal containers away from rats and mice and out of the reach of children.

3. *Defective chimneys and flues.* They may be either improperly constructed or worn out. More care in building and occasional inspection would remedy the defect.

4. *Stoves, furnaces, boilers, and their pipes.* They become overheated or are insufficiently guarded. A plate of zinc or asbestos should be used under a stove, and at its side if necessary to protect a wall. A stove pipe going through a wall or ceiling should have a large collar to keep it from touching the wood. Flues from furnaces should not be placed too close to a basement ceiling.

5. *Spontaneous combustion.* This is frequent in oily rags. If such rags are not destroyed, they should be kept in strong metal containers with tight covers.

Lightning, the next most serious cause of fires, we can do little to guard against, though lightning rods do some good. Sparks on the roof are next in importance. It is easy to prevent their doing damage by covering the roof with an incombustible surface. The asphaltum felts are fire proof and are also cheaper than shingles. Other incombustible roof coverings, such as artificial fiber, slate, and tile, cost at first more than shingles but are much more durable, and in the end more economical.

Petroleum and its products cause many fires. Kerosene should be kept in a can which does not leak, especially if it is put on a wooden floor. It should never be used in kindling fires. Kerosene stoves and lamps should not be filled while they are burning.

Gasoline and benzine are even more dangerous than

kerosene. They should not be stored in the house but in a shelter in the yard. Their containers should be painted red to warn us to be careful. Keep the containers tightly covered. Remember that it is the fumes that catch fire. Neither gasoline nor benzine should ever be used in a room where there is an open fire. Of course a gasoline stove should not be filled while it is burning. Cleaning clothes with gasoline or benzine is dangerous. There are non-inflammable solvents which can be used instead.

One third the accidental deaths of children are caused by burns of some sort. Children are often burned by playing with bonfires. It is not necessary to prohibit bonfires altogether; but little children by themselves should never be allowed to make fires. When they enjoy bonfires in company with their elders they should be taught caution.

To minimize the injury from fires, large and expensive buildings are constructed of non-combustible materials, — steel, tile, brick, stone, cement. Many factories use heavy timbers instead of steel, but have otherwise very little woodwork. Such are called *slow-burning* structures. Though private dwellings are commonly made of rapidly combustible materials, which results in great financial loss from fire, they are so small that the residents can usually escape and there is little loss of life in their burning. It would be better for us to use non-combustible materials more in house building.

In most states the laws require tenements, factories, office buildings, etc., which are several stories high to have fire escapes. Care should be taken that these avenues of escape should not be obstructed by storing things on them, or in front of the doors or windows which lead to them. One of the best safety devices in large buildings is the fire partition, by means of which a building may be completely divided into two or more parts. The openings through these partitions may be closed on a moment's notice by steel

doors. If a fire breaks out in one part of the building the people can all move horizontally into the other part and close the door. At their leisure they can go down to the street and there will be no stampede for the elevators and no one will be trapped above the fire.

There should be plenty of clearly labeled exits from buildings in which many people gather. These exits should always be unlocked and the doors should open outward. Locked doors and inward opening doors jammed shut by the crowd pressing against them have been the cause of many injuries and deaths. Panic often kills more people than the fire itself. Fire drills at school are to fix in pupils the habit of moving in order and without excitement when the fire alarm sounds.

It is said that nearly all fires could be put out within five minutes of their starting if some one were present who could keep his wits and who knew what to do in a given emergency. Burning solids should be doused with water. If water can not be had smother the flames with blankets, with earth, sand, or flour. Water should not be thrown on burning oil; the oil floats on it and spreads. A heavy cloth can be used to smother the flaming oil, or earth, sand, or flour may be thrown on it. A bubbly fluid like suds would float on the oil and smother out the blaze.

A fire extinguisher is very convenient in putting out burning solids and oils. It generates a gas, usually carbon dioxid or carbon tetrachlorid, which falls over the burning object and smothers it out. For the use of the apparatus follow the directions printed on it.

If a person's clothing catches fire he should at once lie down to prevent the flames reaching the face and being breathed in. A blanket, rug, or overcoat should be wrapped around the body to smother out the flames. Simply rolling on the ground may put out the fire. Water should not be sprinkled on the burning clothes lest it be changed to steam

which would scald the skin — a worse injury than that produced by the flames. If water is applied it should be in large enough quantity to extinguish the flames before it can be heated to form steam.

An open fireplace should be carefully guarded not only to prevent sparks flying out upon the floor, but also to keep dresses and other inflammables from being drawn into the flames. The use of candles on Christmas trees is so dangerous that it is being given up and electric lights substituted. We never can be too careful with fire!

Name the five chief causes of destructive fires and tell what can be done to avoid fires in each case. Name three other common causes of fires and tell what can be done to minimize the injury from each. Discuss the dangers from bonfires. Explain how building materials affect the damage done by fires. What care should be taken of fire escapes that their usefulness be not impaired? Explain how a fire wall is a great safety guarantee in a large building. What rules should govern the use of exits? Why do we have fire drills at school? When a fire first starts what should be done to put it out? How should burning oil be smothered out? How should a person's burning clothes be extinguished? Discuss the danger of candles on a Christmas tree. What cautions should be observed with a grate fire?

Falls. — Among the common injuries to children are those resulting from falls. Children naturally climb a great deal. Though they do not often become panic stricken and lose their balance, they have little appreciation of the dangers they incur and need to be trained to exercise care. They should be taught to test the limb of a tree before they trust their weight to it. Ladders should be kept out of their way until they are old enough to go successfully down as well as up. Workers need to be reminded repeatedly that scaffolds and ladders should be made secure.

Obstacles should be kept out of paths, for many injuries come from tripping over impediments. Slippery places are dangerous to people of all ages. Sand or ashes should be

sprinkled on an icy walk, and children should make their slides where they will not endanger pedestrians. No courteous person will drop a banana or orange peel on the sidewalk, but, in the city will find a garbage can for it, and in the country will throw it where it will not offend the eye and where it will not get under foot.

In the summer time when the window is open the screen should be so secure that a child leaning against it will not push it out and fall with it. Stairs should have strong rails that one going up or down may be able to steady himself if he trips. Porches should be well guarded. Any difficult passages in the house, especially a step or two up or down, should be well lighted to prevent a fall in the dark.

How should children be taught to be careful in climbing? Why are banana peels on the sidewalk dangerous? Where should children make slides and where should they avoid sliding? Name some precautions we should use to avoid falls about the house.

The City Street. — The traffic in city streets makes them dangerous to people of all ages. The rapidly driven motor vehicles have increased the danger many fold. We have rules of traffic to reduce the danger as much as possible. The following precepts should be observed:

Cross the street only at the regular crossings; drivers are not looking out for pedestrians in the middle of the block.

Start across only when there is a considerable gap between vehicles or when the policeman has stopped the traffic to make way for you.

Look to your left in crossing the first half of the street and to the right in the second half.

Go forward, not back, if you see a car coming toward you. The driver probably sees you and is planning to go behind you.

Do not step out suddenly from behind an obstacle. Look first to see if a car is coming whose driver has had no chance to see you and to avoid you.

In alighting from a car always face forward, steadying yourself with your left hand on the bar, and stepping with the right foot first to the ground.

Do not put head or hand out of the window.

Do not " hitch on " to any vehicle. You may be thrown violently to the ground or under the wheels, or you may drop off right in the way of another car and be run over.

National Safety Council.

FIGURE 114. — STOP AND LOOK!

On the average in the United States a child is killed every day and two on Sundays by automobiles. Don't run into the streets without stopping to look both ways.

Do not run into the street in any games. Your mind will be on the game and you will not be likely to notice any vehicle coming.

If a plaything rolls into the street do not try to recover it until you have looked in both directions to see if the way is clear.

Do not coast down driveways into the street on sleds, roller skates, or bicycles.

Give as many rules as you can for avoiding street accidents.

Car Drivers. — Familiarize yourselves with the rules of the road and live up to them conscientiously.

Let your motto be safety rather than speed.

Always keep on the right hand side of the road.

Slow up for cross streets and in turning corners.

Do not pass a street car while it is taking on or discharging passengers.

Be unusually careful in passing schools or going through streets where children are playing.

Be sure to give the signal when you are about to stop or turn the corner.

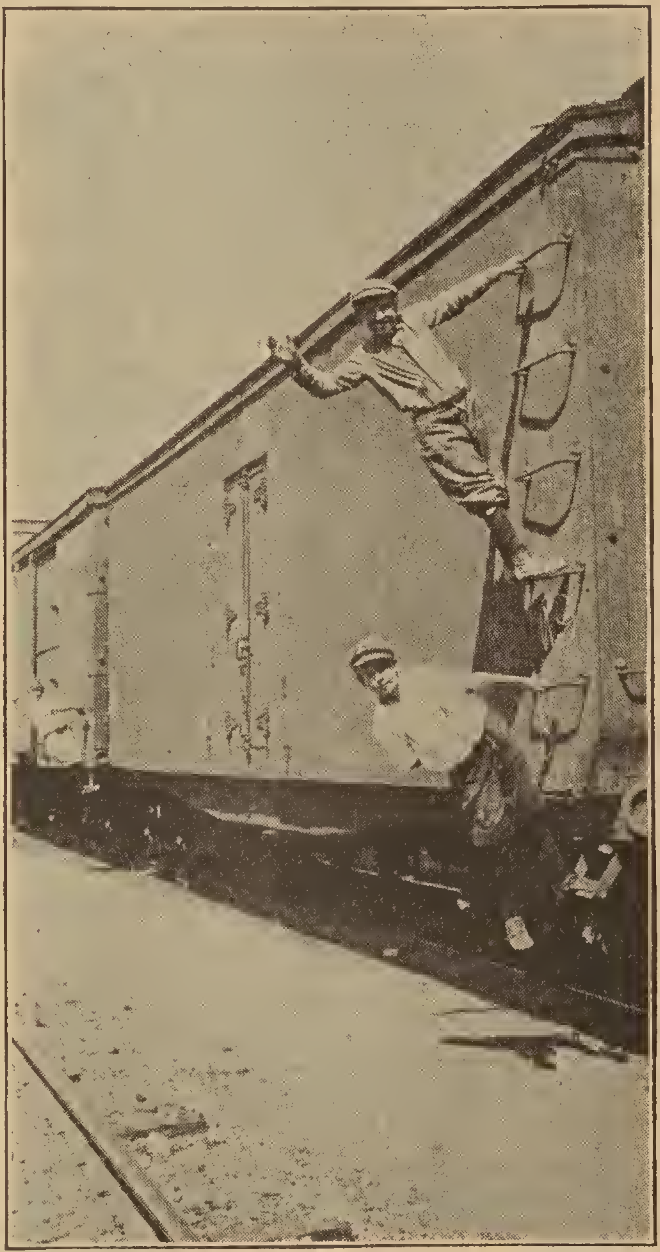
Do not try to look about to see the things which attract the interest of your passengers. Keep your eyes on the road and your mind on your driving. In the country draw up to the side of the road and stop if you wish to view the landscape.

Give rules to be observed by drivers of cars.

Railroads. — We have to depend on railroad officials to make travel safe for the passengers. Our duty is to be careful in getting on and off trains and to sit quietly in our seats in transit. A very large part, however, of the damage done by railroads is suffered by those who are not passengers. Many trespassers on the railroad's right of way are injured or killed through no fault of the railroad managers. People walking along the tracks instead of in the highway are often run down. Men stealing rides are frequently thrown off and run over. Many boys catching rides on moving cars fall under the wheels. The only safe thing to do is to keep away from the yards and the tracks where you have no business. In other countries such trespassing is forbidden by statutory law. It should not be permitted in America.

Horrible accidents frequently occur at grade crossings.

In congested districts we should build viaducts over railways or cut roadways under them for the passage of vehicles and pedestrians, and abolish as far as possible the grade crossings. Where there is considerable traffic at a necessary grade crossing, a watchman should be stationed to guard against accident. Every crossing should be protected by a bell and by flashing lights that give warning of an approaching train. Buildings and bushes should not be allowed to obstruct the view of an approaching train. Automobiles should slow up when coming to a crossing and not attempt to go over until the driver is sure the way is clear.



National Safety Council.

FIGURE 115. — DANGEROUS PLAY.

"Never hop a freight, for nothing quite heals the wound received under grinding wheels."

Though much has been done through employment of air brakes, block signals, well trained and temperate engineers to secure safety for trains and passengers, the lives of engineers, firemen, trainmen, and switchmen are placed in unnecessary danger because all possible precautions are not taken to remove hazards from their occupations. The men are at times very careless, and the management

is slow to install safety devices — because it would increase the expenses of the road and seem to take from the profits. If the primary aim of all roads were safe service there would be fewer injuries and deaths among their servants, and the larger profits would eventually take care of themselves.

How are many trespassers on railway property seriously injured? What should be done to prevent this evil? How can the harm of grade crossings be minimized? How can the lives of the workers on railroads be made more safe?

Water Dangers. — The sea, lakes, and rivers have always been the friends of man, the sources of food, the avenues of travel, the means of healthful recreation. But they have always been fraught with danger. Our problem is how to make the water safe and therefore more useful and more enjoyable. In the first place every boy and every girl should learn to swim and dive. Then if they are sometime thrown into the water in an accident they will know what to do to get out. In the second place, they should learn the limitations of their own powers and the dangers of the water, that they may not expose themselves to inordinate risks. It is folly for a mediocre swimmer to try to swim unattended across a wide stream or lake. A person not in robust health is foolish to dive into cold deep water; the shock of the cold is too liable to make him helpless.

Some valuable precautions for swimmers are:

Do not go far from land unless attended by a boat; even very good swimmers may get cramps and need help.

Do not stay in the water until you become cold and your lips blue.

Do not go in when you are exhausted or just after a hearty meal.

Do not dive unless you know the water is deep enough.

Wear ear plugs when you dive if the water affects your ears.

Most of the lives lost in boating could have been saved if the victims of the accident had known how to swim. The most common accident to rowboats and canoes is tipping over. Therefore do not rock the boat. Do not try to change seats, or stand up for any purpose. Do not lean over the side. Go out in a boat only with some one who knows how to manage it and can swim. In passenger ships there should be lifeboats and rafts sufficient to accommodate every passenger, and a cork jacket or other life preserver for each. When a person goes on board the boat he should learn where the life preservers are so that he will not be delayed in finding them in case of accident.

Skating is one of the best of winter sports, but the danger of thin ice should make us cautious. In a river the danger is greater than in a lake since the current is likely to carry one who breaks through down under the ice beyond rescue. We should take the precaution of trying the ice over shallow water first and not venturing on newly frozen patches without first inspecting them. To rescue a person who has broken through throw him the end of a rope tied in a noose, or take off your coat and use it for a rope, or reach him a board.

Explain the value of learning to swim and dive. What precautions should swimmers observe? What should a person in a rowboat do to avoid accident? What precaution should a passenger on a steamboat observe? What should a skater do to avoid breaking through the ice? What can you do to help a person who has broken through the ice?

Machines and Tools. — All machines and tools, whether on the farm, in the village, or in the large factory, are a source of danger. The machine or implement should be planned so as to reduce to a minimum the danger of using it. In using it one must be constantly on guard lest carelessness bring one to grief. All belts, shafts, and gearings should be protected by railings and guards. Power saws, punches, and planes — in fact nearly all machines — are now made with

protecting devices to save the fingers and arms of the workmen. It is inexcusable not to use the best means of protection conceivable.

A good light on one's work is a valuable safeguard. Men get their fingers and hands injured because they do not see

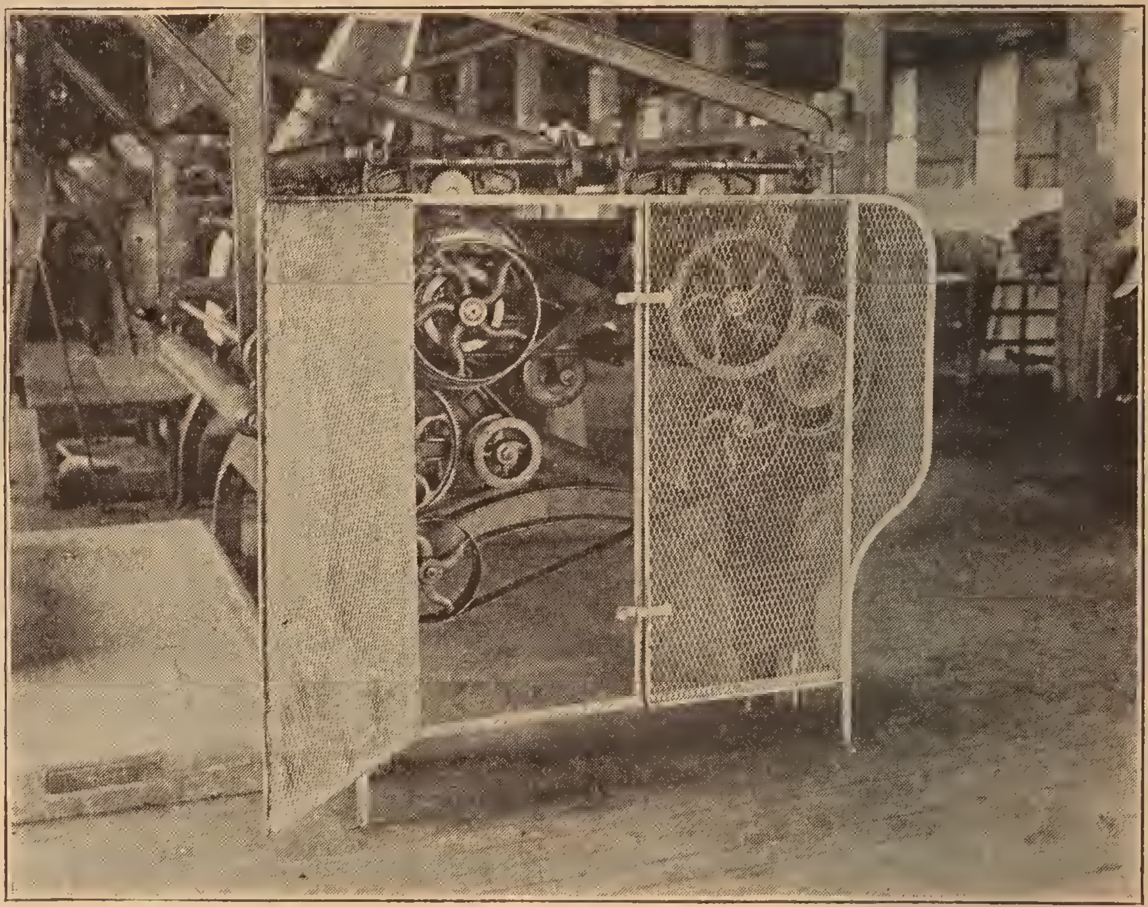


FIGURE 116. — MACHINE GUARD.

This illustrates how machines are carefully guarded, that the workman who tends the machine or anyone passing by may be protected from injury.

the parts of the machine clearly. A proper illumination also conserves the eyesight.

No matter how well the machine is protected the worker is likely to be injured if he relaxes his vigilance. When he gets tired he is more likely to become careless. Accidents are more common just before noon and especially in the late afternoon. The more tired a workman is the more he should strengthen his determination to be careful. It is unwise for a man to extend his work day to the point of fatigue.

Carefulness is a virtue which can be increased by training, and which goes only with a capable mind. Children and men of very limited intelligence should not be allowed to work with the more dangerous machines. A man should be promoted to such work only when he has proved his carefulness and his sound judgment in emergencies.

What can be done by a factory owner to minimize the dangers of his machinery? What is the workman's part in avoiding accidents? When should he be particularly on his guard? How can a man qualify for work on a dangerous machine? Why is a good light an important safeguard in a factory?

Electricity. — Besides causing many destructive fires, electricity injures or kills a large number of men who work with it. It has been especially dangerous since the very high currents have been used for long distance transmission. A workman gets careless and lets his body touch the wires, a short circuit through his body kills him instantly. It is never safe for a boy to climb a pole carrying wires. He is not able to tell the high potential wires from those carrying harmless currents. A touch may snuff him out of existence.

Wires are sometimes broken in such a way that one end drops to the ground, flashing and sputtering where it hits. If it is either a trolley wire or a cable carrying a heavy current it is dangerous. The first person who discovers it should stand guard warning people away from it until a policeman is called to take the matter in charge. If a man has been struck and knocked down by the wire he should be pulled away carefully — so carefully that his rescuer be not also caught in the electric circuit — and attempts made to restore him to consciousness. Artificial respiration (see page 255) should be used if breathing has stopped.

Why should boys never climb poles carrying electric wires? What should be done when a wire carrying a heavy current breaks and one end falls down? If it hits a man what should be done for him?

Poisons. — To prevent disasters from the few necessary poisons which should be kept in every household the following precautions should be observed:

Keep no more poisons in the house than you really need.

Have every package or bottle clearly labeled with a poison warning mark.

Never take any medicine in the dark. Read the label and be sure it is what you want.

Do not keep poisons on the same shelf with medicines.

Put them on a high shelf out of the reach of children — better under lock and key.

Be prepared to use the proper antidote for each of the poisons you have. See page 251.

Learn to recognize poison ivy and poison oak and any other poisonous plants that may be in your locality, that you may avoid them.

What precautions should we observe to avoid poisons?

Dangers in Food. — Luckily for us, the serious dangers in food are not common. If we sometimes take food that is a little spoiled, in which there is an unusual number of germs, we may have a touch of indigestion, but commonly it is not very bad. There are, however, several harmful substances and disease germs sometimes taken in food. They are discussed on pages 103 to 105.

A good rule is not to eat or drink things unknown. Few things have so direct and deep reaching an effect on our health as does our food. For a full discussion see Chapters IV and VI.

What is a good rule for avoiding dangers in food?

Firearms and Explosives. — The use of firearms is a mere survival from an outgrown past. In pioneer days in America, lasting until a generation ago, guns were useful for self-protection and for supplying the family with meat. Now there is no more game to be shot except in a few practically

inaccessible places, and a man is safer without a gun. No one but an officer of the law is justified in carrying arms. There should be no guns or pistols about the house for children to get hold of. If there is an old relic it should never be loaded. The argument that it is necessary to keep a pistol in the house for protection against burglars is weak, since burglars also are usually armed, and one has at best only an even chance with them. Children will find guns somewhere. They should be taught never to point them at anyone, whether loaded or not. Most accidental discharges with direful consequences have been of guns thought not to be loaded. Play guns which children point at things and people and pretend to shoot are responsible for a great deal of our vicious gun thought and conduct.

Within the last few years a wave of common sense has swept over the country with regard to the celebration of Independence Day. We no longer think it necessary to manifest our patriotism by blowing off fingers and putting out eyes with explosives. Fireworks have a certain attractiveness. Let them be burned by men who understand them and are trained to be careful, while we admire from a safe distance. The best advice to give to one who wants to play with fireworks is "Don't."

The thousand and one little devices invented to make explosives safe are futile. The only safety lies in letting the dangerous things alone. Blank cartridges and toy pistols for the explosion of paper caps occasionally produce fatal injuries. There is always a crop of tetanus (see page 225) after a Fourth of July celebration. Don't use explosives. Celebrate by means of games and pageants, in ways that call out the activities of the body and mind, that challenge your wit and skill.

Why is there no longer any good reason for having guns in the house? Why are they dangerous? What dangerous play with a gun should never be allowed? Discuss the injuries which come

from Fourth of July celebrations. How is tetanus often produced? What better means have we of celebrating a holiday?

Practical Jokes. — When the fool goes after fun he thinks he must get it at the expense of some one else. He expects to have a laugh at some one's discomfiture or annoyance, and so he pulls the chair from under a man about to sit down — and injures him seriously; he puts powder in a cigar — and ruins the smoker's eye; he ties strings across the path — and breaks his victim's arm. The practical joker's mind is fertile; there seems to be no end to the schemes he can devise to injure his friends. But his mind is shallow; he doesn't think, beyond the laugh, of the injury he is likely to bring by his jokes. He doesn't mean to do harm; he just doesn't think. But we ought to think. Safety first ought always to be in the foreground of our minds, — safety first and fun which does not require a victim.

Explain how a practical joke is the product of a small mind. How will people who have a better developed intellect get their fun?

CHAPTER XVI

IN CASE OF ACCIDENT

The chapter on accidents is the longest chapter in the book.
— SOUTHEY.

In case of serious accident always get the help of a doctor as soon as possible. If the injured person can be moved, take him to a hospital if one is accessible; if not, to the doctor's office. The hospital and the doctor's office have facilities for caring for injuries which our homes lack. If you must call the doctor to the patient tell him as much as you can about the injury that he may know what instruments or appliances to bring. The suggestions here given are for first aid, to be used while waiting for the doctor, or in an injury so slight that the doctor's aid is not needed.

Why is it better to take an injured person to a hospital or doctor's office than to the home? If you must call the doctor to your home, what information should you give him with the call?

Broken Bones. — First aid for broken bones aims to keep them undisturbed. If the break is in the leg, lay the patient down, legs straight, and gently bind a stick or something stiff beside the leg to keep it from moving at the break. It is well to wrap the legs together. Prop with pillows, if possible, to avoid any strain. A broken arm should be stiffened by a stick wrapped beside it and should be carried in a sling. If the patient can lie down and await the doctor's coming, his arm may be made most comfortable by laying it in a semiflexed position on a pillow. For a broken collar bone or hand or finger bones, put the arm in a sling. For

broken foot or ankle bones keep the patient lying down as much as possible. If the end of a broken bone projects through the skin (compound fracture) be very careful not to touch it or to let any wraps touch it. It may not be already infected, but will be if you get your fingers on it.

State the method you would use for each of the following bones to keep a break from moving; hand, foot, leg, collar bone.

Sprains. — The rule for treating a sprain is: *Keep the joint still.* To prevent movement a secure bandage is put on. The pain can be decreased by hot applications, — wet compresses, hot water bag, electric pad, or light.

Why should a sprain be kept quiet? Why is a bandage put on? How can the pain and swelling be reduced?

Bleeding. — Most accidents injure veins and very small arteries. To check the bleeding, place a surgically clean pad over the wound and bind it down moderately tight with a bandage. If the bleeding is not profuse you can take time to sponge around, not in, the wound and apply iodin to the skin around it before you put on the dressing. In rare cases an artery of considerable size is cut. This can be recognized by the spurting of the blood in jets. To check the bleeding a strong bandage should be tied above the cut, and a stick put under it and turned to twist the bandage very tight. This *tourniquet* (*-ket*) should not be used unless you are sure an artery has been cut; you are more likely to do harm than good with it. The bandage must be made very tight or not used at all. If it presses only a little it checks the venous return without stopping the arterial flow.

To stop nose bleeding hold the head up; put cold water or any cold object on the nose, forehead, or back of the neck; plug the nose moderately tight with a wad of absorbent cotton. If the bleeding does not stop, a plug of cotton soaked in hydrogen peroxid may be used with good effect.

What can you use for a clean pad to put on a wound? Why is it well to apply iodin to the skin at the sides of the cut? How can

you tell when an artery is cut? What should be done to check the flow of blood from an artery? What harm results from this bandage being too loose? What should be done to stop nose bleeding?

Poison. — The main thing to do with poisons in the stomach is to get them out as soon as possible. If possible the stomach should be emptied promptly, without waiting for a doctor. To induce vomiting, drink tepid water; drink a cup of water with a spoonful of mustard in it; tickle the throat with the finger thrust as far in as possible. If phenol (carbolic acid) or lye has been swallowed drink a small cup of oil before causing vomiting. The oil will prevent severe burning of the lining of the mouth and nose when the poison is thrown up. For metallic poisons, *e. g.*, mercuric bichlorid, the white of egg taken into the stomach will do some good. As an antidote for iodin, administer boiled starch and water or boiled or baked potato. Never put a poison on your shelf without posting on the bottle the antidote for it, and having the antidote handy.

What is the general emergency treatment for poisons in the stomach? Name three things which can be done to induce vomiting. For what poisons should oil be taken? For what should white of egg be used?

Choking. — If a child chokes, have him hold his hands above his head while you slap him vigorously on the back. If this does not dislodge the obstruction, have the child lie down on his face while you slap his back. A small child should be held by the feet, head down, and shaken or slapped on the back.

How would you dislodge from the throat an obstruction which stops the breathing?

Splinters. — To pull out a splinter, put the point of a knife blade under the splinter and press the splinter down on the blade with the thumb nail. For a small splinter a needle may be sufficient. Disinfect the puncture with iodin or alcohol.

How can you pull a splinter out of your skin?

Bites and Stings. — Insects in biting or stinging usually inject an acid poison which irritates the skin. Although the injury is rarely serious the annoyance is considerable. The irritation can usually be allayed by sponging with hot water and applying baking soda. If you can see a stinger in the skin pull it out as you would a sliver.

What should be done for insect bites and stings?

Poison Ivy. — Besides poison ivy and poison oak there are a number of plants which by mere contact produce a rash or blisters on the skin. Some of us seem immune to their poisons, while others are affected in degrees varying from a light rash to severe sickness. If you are susceptible, sponge the skin with alcohol and then wash in water as soon as possible after exposure. Among the many remedies recommended, lime water, dilute phenol, and photographer's hypo are commonly at hand. A severe case should be put in the doctor's care.

What poisonous plants can you recognize? How do they affect the skin of those who are susceptible? What should be done to prevent, and to relieve the irritation?

Infected Punctures. — The teeth of a dog, or nails, or other dull instruments make punctures which bleed little and are nearly always infected. They should be treated at once with a strong antiseptic. Take in a dropper a few drops of strong iodin or phenol undiluted, thrust the point of the dropper as deep into the puncture as possible and force the antiseptic into the wound. This is called *cauterizing* the wound.

What wounds should be cauterized? How would you do it?

Scrapes and Scratches. — If scratches from thorns never suppurate in your skin, you need not bother to do anything for them. If they have a tendency to form pus, treat them as soon as possible with strong iodin. Scratches from the

claws of a dog or cat should always be well sponged with iodin immediately. If you get "floor burn" or any other scraping injury in the gymnasium put iodin on at once. For any break in the skin iodin is the best antiseptic.

What should be done to prevent pus forming in any broken skin? Why are scratches from dogs or cats especially likely to suppurate?

Burns. — An extensive or deep burn is a serious matter and should be referred to the doctor. If possible avoid touching it while waiting for the physician. For a slight burn the main thing is to grin and bear it. Lime water and linseed oil in equal parts or baking soda wet or dry may relieve the pain somewhat. If the skin is broken, care must be taken not to infect the raw surface. It is better not to bind it with a tight dressing, but cover it loosely with strips of aseptic gauze — *not absorbent cotton.* Still better, if it can be kept clean, leave it exposed to the air.

What should you do with a serious burn while waiting for the doctor? What treatment is recommended for small burns? If germs are in the burn would they be more likely to grow under a bandage, or in the open?

Frost Bite. — The time-honored direction to rub a frozen ear or nose with snow must be taken with caution. If the weather is very cold, the snow will freeze the face and make a bad matter worse. In polar regions a warm hand is held over the frozen member till it thaws out. The process of thawing should be gradual to avoid inflammation afterward. Out of doors the thawing will probably not be too rapid. If you come into the house with a frozen ear you may well hold snow over it to keep it from changing temperature too rapidly. Slapping and rubbing will stimulate the blood circulation. When the frozen part begins to redden, active treatment should be stopped.

Why is it objectionable to rub a frozen ear with very cold snow? How do polar explorers warm frozen spots in the face? How do slapping and rubbing affect the temperature?

Fainting. — A person becomes faint because of insufficient oxygen in the brain. Faintness may be caused by reduced oxygen in the atmosphere, by some defect in lungs, heart, or blood vessels, or by an emotional interference with the normal circulation. Whatever the cause, the first aid treatment is the same. Lay the person down flat — if convenient, the head a little lower than the body. Hold smelling salts or ammonia (with caution) to the nostrils. Sponge the face with cool water. Loosen tight clothing. Keep inquisitive people away and make room for fresh air. Consciousness will be regained in a few minutes if nothing serious is the matter. If the case is serious, your treatment has done no harm.

What affects the brain to cause fainting? To what may the lack of oxygen be due? What should be done to a fainting person?

Epilepsy. — The epileptic fit can be distinguished from a faint by the spasmodic contractions of the muscles. If you let the epileptic lie on the floor he is less likely to injure himself or others. There is some danger of his biting his tongue. To prevent this, wedge something between his teeth, — a knot in a handkerchief, a cork, a piece of soft wood. Consciousness will soon return.

What is the only thing you need do for anyone in an epileptic fit?

Suffocation. — If oxygen is excluded from the lungs a person suffocates. The two most common causes of suffocation are asphyxiation by illuminating gas in a close room, and drowning. In either case the lungs are cut off from the air supply, and filled with gas or water. The thing to do, obviously, is to get oxygen back into the lungs as soon as possible. If the patient is unconscious in a gas-filled room he must be carried out into the fresh air and restoratives applied, as in the case of fainting. He will probably recover consciousness soon.

If he has breathed the gas for so long that his respiration

and heart beat are very slow it is a case for the doctor. While waiting for the doctor artificial respiration will be necessary if the breathing stops. Lay the patient face downward. Stand or kneel astride him, facing toward his head. Stoop down and with your hands (thumb and fingers parallel) grasp his body at the height of the floating ribs. Swing your knees in against your arms and with the force of your arms and legs press the body between your hands. At the

FIGURE 117. — ARTIFICIAL RESPIRATION.

This method of resuscitation is applied to a person rescued from the water, asphyxiated by gas, or unconscious from electric shock.

same time throw your weight a little forward and press down with the "heel of your hand" on the patient's back. Swing yourself a little backward and release the pressure. Press again, release, and so on, pressing every three or four seconds. When the patient begins to breathe by his own muscular contractions, turn him over and see if he will keep it up without your help.

Artificial respiration should be applied if a person is found after the breathing has ceased and the body is still warm.

It should be kept up for an hour or more if the patient does not recover sooner.

In restoring a drowned person you must get the water out of the lungs before you can get the oxygen in. Turn him on his face, stand over him, put your hands under his abdomen and lift his hips two feet from the floor. If some-one else is present, have your companion slap the patient's back. Repeat, if necessary to get the water to run out. Then practice artificial respiration to get the air into the lungs. The patient's cold, wet clothes should be stripped off and he should be wrapped in a warm blanket. His arms and legs should be slapped and rubbed toward the body to help the circulation.

Such an apparatus as the *pulmotor* is for the expert. Others are likely to do more harm than good with it.

What are the two most common accidents which produce suffocation? What should be done with a patient rescued unconscious from a room full of gas? If the patient has stopped breathing what should be done while waiting for the doctor? How does the carbon monoxid in illuminating gas affect the one breathing it?

What is the first thing to do with a man pulled out of the water unconscious? Describe artificial respiration. What should be done to increase the blood circulation and warmth of the patient?

Antiseptics

Of the many good antiseptics one should choose a few and have them always ready for use. *Keep them safely out of the reach of children.*

Boric Acid. — Boric (boracic) acid is the one thing anyone can use in the eyes without harming them. Buy it in the form of either a powder or crystals. Prepare only a little at a time and do not try to keep the solution more than a few days. Use boiled water, about one fourth of a cup or less. Drop in the boric acid till no more will dissolve. In applying it to the eye use a clean dropper or absorbent cotton. Do

not dip the used cotton into the boric solution but take a clean piece each time.

What is the chief thing for which you would use boric acid? How would you prepare it? Why only a little at a time? Why *boiled* water? How apply it to the eyes? Why not dip the used cotton back into the boric solution?

Iodin. — Buy the strong tincture from the druggist. It is the best disinfectant for you to use in cuts and scratches and for cauterizing bites and punctures. A convenient applicator is made by twisting a wisp of cotton around the end of a toothpick or longer splinter of wood. You must not use iodin in the eye or on the mucous membrane.

What is the best disinfectant for scratches and cuts? How apply it? Where should you not use it?

Mercury Bichlorid. — The most convenient disinfectant for washing the hands or cloths is mercury bichlorid. It is mixed with citric acid and made into blue tablets called *antiseptic tablets.* Dissolve a tablet ($7\frac{1}{2}$ gr.) in a pint of water (3 or 4 pints for the hands) in an enamel or earthenware dish. (It corrodes metal.) It may be used freely for disinfecting hands and cloths, but is irritating to wounds and must not be used internally.

If you get disease germs on your hands what would you use after soap and water to clean them? What would you do with infected handkerchiefs and wash-cloths before sending them to the laundry? Why not mix a bichlorid solution in a tin or galvanized iron dish?

Phenol and Lysol. — Phe'nol (carbolic acid) and ly'sol do not tarnish instruments as mercury bichlorid does, and are used for disinfecting metals, as well as hands and cloths. To prepare the solution put about a pint of water into a basin and add a spoonful of the strong antiseptic. Undiluted phenol will burn the skin. Be careful not to touch it.

For what are phenol and lysol used? How is the solution prepared? What caution should be observed?

Hydrogen Peroxid. — People use "peroxid" altogether too much, — thanks to the shrewd advertiser. It is not so good an antiseptic as those named above, but it is very good to wash out pus. It must not be injected into cavities from which it can not escape freely when it bubbles up; but dropped on pus surfaces it cleans them up very well. It is useful to check bleeding in the nose or mouth.

For what do people sometimes use peroxid when they would better use iodin? Would you use it on a boil that has been opened? When would you use it in the mouth or nose?

Fumigation. — We fumigate clothing, rooms, and whole houses to rid them of insects and vermin of all sorts as well as of disease germs. To fumigate a closet full of clothes, to kill moths and other pests, pour a tablespoonful of carbon bisulfid into a dish, set it on a high shelf in the closet and shut the door. Caution! It is inflammable. Do not bring fire near it. It has a very strong odor.

A good room fumigator is formalin (formaldehyd). Before proceeding to fumigate, moisten the air of the room thoroughly by boiling water in it or spraying warm water into the air with an atomizer. Spread out in the room everything that is to be fumigated, open the bed and shut the windows tight. Hang a sheet on a line stretched across the room, sprinkle a pint of formalin on it and quickly go out and close the door.

The most convenient fumigators are the paraformaldehyd "candles." You must prepare the room as for any other fumigation, then stand the fumigator in a basin of earth or water to guard against fire, and light the wicks. The heat vaporizes the paraformaldehyd, which is in a little cup above the flame. Full directions are in the package.

Formalin fumes kill bacteria but do not kill bed bugs. A better fumigator for insects is obtained by burning sulfur. After the room is prepared the stick of sulfur (called a *candle*) is put, for protection against fire, in a basin which is set in a

larger basin or tub containing earth (or water). After lighting the sulfur go out quickly and close the door. Sulfur fumes bleach; use formalin when you want to protect the color of hangings or other fabrics. The fumes should remain in the closed room at least several hours, a day if convenient. After the room has been well aired it is ready for occupation.

The best means of disinfecting clothing is to keep it in boiling hot steam for an hour. This does not harm the clothing and leaves it free from germs or vermin of any kind. It requires more apparatus than can find a place in the home. Every considerable community should have a public plant to serve the needs of all.

What is the purpose of fumigation? How is carbon bisulfid used to fumigate a closet or trunk? What caution should be observed in its use? What is the most convenient room fumigator? Explain how it is used, two ways. For insects what is a better fumigating agent than formalin? What great caution should be used in applying it? When would another fumigator be preferable? What is the best means of disinfecting clothing? Why should the municipality provide the plant for this work?

Soap and Sunshine. — In our ardor for fumigating we must not overlook the value of cleaning. Soapsuds and the scrubbing brush are excellent disinfectants. Sunshine kills some kinds of germs more quickly than fumigation does. Roll up your shades and let the sunshine in. Don't value the colored designs in your carpets or rugs more than you do the health of your family. Hospitals rely on cleanliness, light, and fresh air for getting rid of disease germs more than on fumigation.

It was once the custom to burn the bed and clothing used by a smallpox patient, and still is the practice where there are no conveniences for adequate disinfection. Fire is an effective agent for killing germs. It is wise always to consign infected articles of slight value, such as simple toys, papers, and cheap books, to the flames.

In moving into another house, what precautions do you take to avoid disease germs? Why is it important that the floors be smooth? Why is sunshine in the home so desirable? If you have no further use for the toys and books that amused your sick child, is it an act of kindness to send them to poor children? Give the reason for your answer.

Historical Note. — Nowadays, antiseptic treatment of wounds is accepted altogether as a matter of course. It is so much a part of our everyday life that we do not realize it is one of the two greatest steps of progress in surgery. The use of anesthetics and the proving of the theory that infection is caused by bacteria are the two discoveries that have made modern surgery possible.

In 1842, Dr. Crawford W. Long, a native of Georgia, was a professor in the University of Pennsylvania. A pupil of his, who was a drug clerk, told him one day how young drug clerks amused themselves by whiffing the fumes of sulfuric ether until they lost consciousness. Dr. Long immediately saw the surgical possibilities of the drug. That year he performed an operation on an etherized patient, and within the next three years, successfully repeated his experiment several times. But he did not publish an account of his findings, and the surgical world knew nothing of his work until 1849.

In 1844, Dr. Horace Wells, a dentist of Hartford, performed a dental operation on a patient under the influence of nitrous oxid (laughing gas). He related the experience to other dentists and surgeons and told of experiments he was making with ether. Two years later, as a result of further investigations prompted by Dr. Wells' work, an operation was performed by Dr. Morton and Dr. Jackson in the Massachusetts General Hospital on a patient anesthetized with ether. This was the first *public* use of an anesthetic in the performance of a surgical operation. There has been much controversy as to who discovered the use of anesthetics. It seems clear that the honor belongs equally to Drs. Long

and Wells, since neither was aware of the work of the other. Although Dr. Long was the first to use ether as an anesthetic, Dr. Wells has been more generally credited with the discovery, since it was through him that the process first became known to the world.

In 1847, Dr. Simpson of Edinburgh discovered the anesthetic property of chloroform. From that time, chloroform became the most widely used anesthetic in Europe and ether in America.

The use of anesthetics made it possible to perform many operations that had hitherto been impossible. But the percentage of deaths from "hospital gangrene" remained enormously high. It was commonly believed that a wound had to grow worse before it could grow better, in order to rid the body of the poison. But there were advanced thinkers, notably Dr. Lister in England and Dr. Oliver Wendell Holmes in America, who believed that the sources of infection were from outside the body. It remained for Louis Pasteur, one of the greatest of French scientists, to prove, in 1866, that bacteria were the cause of infection. Dr. Lister was the first surgeon to follow up this discovery with the consistent use of antiseptics in his practice of surgery. His work with disinfectants and antiseptics led the way to all the marvels of modern surgery, and he is therefore rightly known as the father of modern surgery.

During our Civil War, surgery as a science was very crude. While anesthetics made the operations painless, the resulting mortality was terrible. The surgeons unwittingly infected the wounds that they dressed. Ninety-nine per cent of all abdominal operations in those years were fatal. So were sixty per cent of all other major operations, such as the removal of an arm or a leg.

With the development of antiseptic treatment, in the sixty years since Pasteur's discovery, conditions have been almost reversed. Very few surgeons of this generation have ever

seen a case of "hospital gangrene." Nowadays, many abdominal operations are performed with comparative ease and safety. In the case of appendicitis, for example, where operations are performed by skillful surgeons within twenty-four hours after the acute trouble begins, there is practically no loss of life. The removal of an arm or leg is accomplished without great danger to the patient. But better than that, antiseptic treatment has made it possible to prevent amputation in thousands of cases where it would formerly have been imperative. In the recent Great War, the Carrel-Dakin method of irrigating wounds with a non-irritating antiseptic made it possible to heal wounds that were considered fatal less than ten years ago.

Truly Long and Wells, Pasteur and Lister, and all those patient men of science who have since refined the work of these discoverers, are among the greatest benefactors of their race.

What are the two discoveries that made modern surgery possible? Tell the story of the discovery of anesthetics. How did Lister make practical use of Pasteur's discovery? Compare the work of surgeons in the recent Great War. Who are the four men to whom modern surgery owes its beginnings?

CHAPTER XVII

THE HEALTHFUL HOME

Ah! What avail the largest gifts of Heaven
When drooping health and spirits go amiss?

— THOMSON.

Our studies in the preceding chapters have been largely of the care of the body. In this chapter we shall study how

FIGURE 118. — A POOR PLACE TO LIVE.

This shows some "homes" of the poor in a large city. The houses are crowded between factories. There is no planning for decency, comfort, or health. The construction is of the cheapest quality, for the buildings may be torn down soon to make room for factories.

to make the home contribute to the health of the members of the family. Our first concern is where to establish the home.

City Homes. — In providing for good city homes one of the most important plans is the zoning system. In the past, cities have grown up without planning. A man might buy land wherever he could and put up a building for any use he chose, with little restriction. As a result we have a most ridiculous and unhygienic mingling of residence houses and flat buildings with stores and factories. The zone system plans to protect the home from the noise, dust, smoke, foul odors, and street confusions and dangers which attend much of our industrial life.

According to this system certain parts of the city will be reserved for family homes, where there will be gardens and playgrounds for children. Other places will allow of apartment houses built according to certain health-conserving restrictions. Schools, churches, and libraries will be near the residence areas and convenient to transportation yet away from the disturbances and dangers of machinery and traffic. The stores and small factories will be situated chiefly on the streets where cars are run. The manufactories will be located at certain places convenient to the means of transportation, yet not all grouped in one locality but scattered in various parts of the city near residence districts, that workmen may walk to their jobs and still live in comfortable and healthful homes.

This method of rationally planning the development of a city is being used in a number of American and European cities. It is not generally applied to the parts of cities already built up, where it would require expensive alterations, but the newer growths are planned according to the zone system. It has proved satisfactory not only in large cities like New York and St. Louis but also in small cities and villages. It promises to be a most valuable means of securing healthful homes for city dwellers.

In the meantime, while waiting for city zoning to secure well-protected places for our homes, we must choose our

location as best we can. We must consider convenience to work and transportation, price of rent, and general tone of the neighborhood as well as purity of air, absence of smoke and noise, and nearness to park, church, and school.

Point out as many evils as you can in our present planless city building. What is city zoning? In what particulars would it improve our present city arrangement? To what extent is city zoning practicable? What considerations should guide us now in choosing a location for our home?

FIGURE 119. — A GOOD PLACE TO LIVE.

A city home may be as beautiful and healthful as this if the city is properly zoned so that manufacturing and business do not encroach on the residence areas and raise the price of land so high that a man with a moderate income can not afford the space for a lawn.

Rural Home Site. — The owner of the rural home chooses the site largely by reason of land features. The surface should be fairly level and the ground well drained. The area should be sufficient for all the outbuildings and gardens, for shade and fruit trees. The water supply should be convenient. If the climate is severe there should be protection from the winter winds, — either tall trees or a hill. A feature sometimes overlooked is the beauty of scene. The house

should be so situated, if possible, as to give from porch and window a view over valley, meadow, field, or lake, — something to bring cheer and sunshine into the lives of the home toilers.

What sort of place should we choose for a rural home? Why should we pay attention to the outlook?

FIGURE 120. — ZONE THE CITY!

A fine residence opposite a small park has been spoiled by the building of apartment houses, crowding against and overshadowing it. A zoning law restricting the buildings along this street to single residences would have protected it.

Home Construction. — When we have selected the city district in which we wish to reside, the question of apartment comes up. Among the first considerations in choosing a house or flat are air and light. Every room should have a window, opening not into a narrow shaft three or four feet wide, but into a large court or the wide outdoors. The more rooms the sun enters the better. The gas or electric light

should be sufficient to illuminate every passage and corner. Dirt hides in dark places.

The plumbing should receive careful attention. There should be no wet places. The bath room should be well warmed in cold weather, to make a bath inviting. The surfaces of the tub and lavatory should be smooth, that they

FIGURE 121. — AIR AND SUNSHINE.

A back yard in a rural home, showing what can be done to promote beauty and health without great expense.

may be kept clean. The floors and walls should be even and tight, the more easily to free them from dirt and vermin. The heating arrangements should be so generous that plenty of fresh air can be brought in without chilling the rooms in winter.

The problem of rural house construction involves most of these features and several additional matters. The basement of the farm or village house is often a weak point.

It should be made dry, and rat-proof. A cement floor and stone or cement walls will be sufficient for this if the house has a well-drained site. The basement of the rural house is used so much for the storage of vegetables that one part of it should be walled off from the heating plant and kept cool in winter, barely above the freezing point.

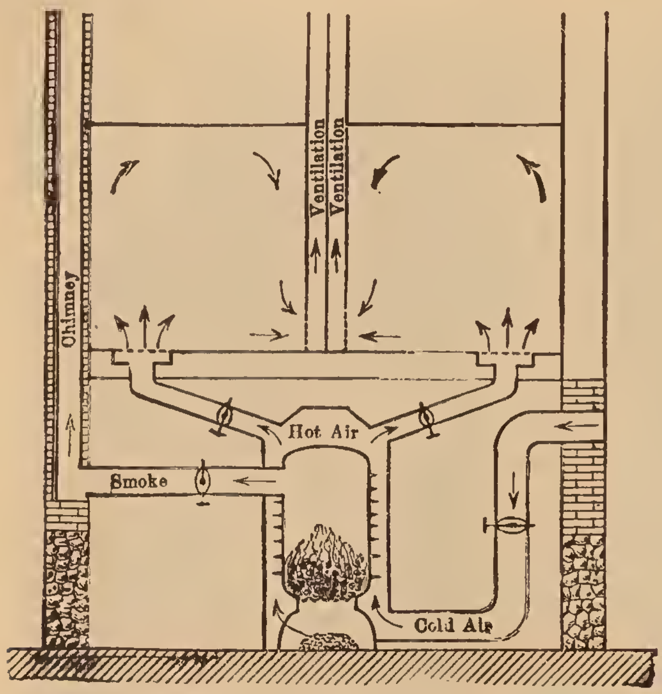


FIGURE 122. — A HOT AIR FURNACE.

This system of heating a dwelling has the virtue of ventilating the rooms thoroughly. A constant stream of cold air is brought in, warmed and distributed through large pipes from the top of the furnace. This fresh air drives out, through the ventilator shaft, the old air of the room and takes its place.

The modern house in a village or in the country can be heated almost as economically by means of a hot air furnace or by hot water as by separate stoves in the rooms. The single heating plant is much to be preferred. It keeps the temperature more nearly even, the fire danger is less, the ventilation (especially with hot air furnace) is better. The unified plant is necessary if there is running water in the house.

When you go flat hunting what requirements shall you have in mind for the windows? for the artificial lights? for the plumbing? for the bath room and its fittings? for the floor and walls? for the heating appliances?

What are the attributes of a good basement? Why is a unified heating plant better than separate stoves?

The Kitchen. — Keep the kitchen clean. Grease or bits of food in sinks, on table, in corners or along the edges of the floor, decay and mold or render the kitchen altogether too inviting to mice and all kinds of insects. In apartment

buildings, it sometimes happens that we get the overflow of these pests from other apartments. Traps kept set continuously will eventually rid a place of mice. Sodium fluorid mixed with equal parts of flour or talc will effectually discourage water-bugs and other insects of the kitchen. (Sodium fluorid is the base of most of the insect powders.) Keep all food under cover, especially if there is danger of contamination by mice or insects.

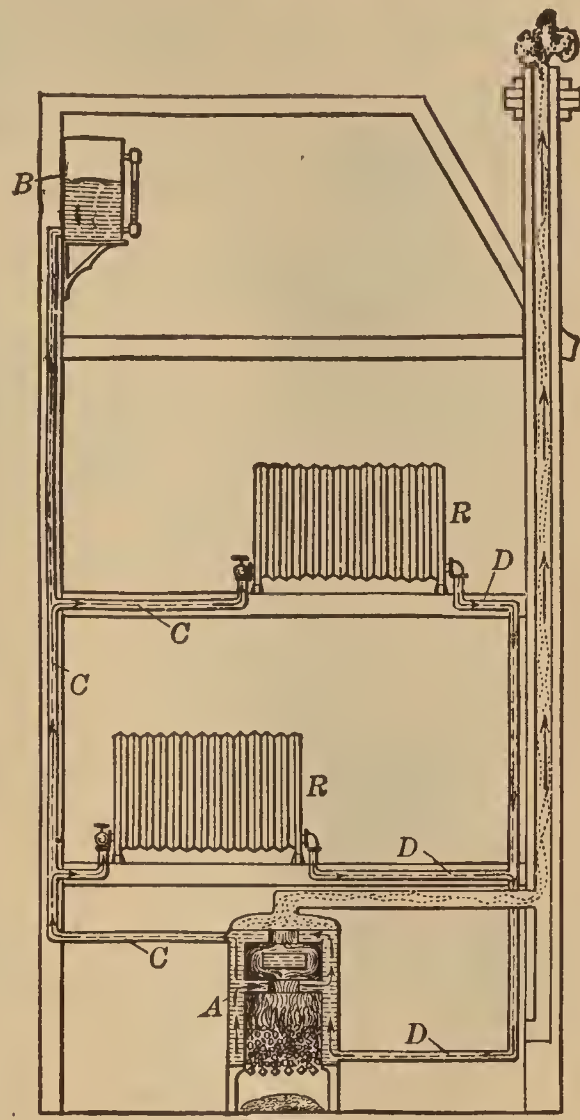


FIGURE 123. — HOT WATER HEAT.

This diagram represents a hot water heating plant in a dwelling house. *A* is the furnace in the basement. *C C C* are the pipes carrying the hot water to the radiators *R R*. *D D D* are the pipes returning the water from the radiators to the furnace. *B* is the feed tank in the attic which keeps the pipes always full of water.

Floors and Their Care. — In the larger and more expensive houses hardwood floors are almost universal. On them are laid without fastenings thick rugs which are easily removed for cleaning. The smooth floors are wiped off with an oil mop and little dust is raised to pollute the air. The dusting is done with a damp or oily cloth which picks up the dust instead of flirting it around.

The same methods could be followed in the smaller and less expensive houses. If narrow hard pine flooring is laid tight and oiled it makes a fairly hard, smooth floor on which rugs can be used and carpets need never be nailed down. The same care can be

observed in sweeping with a soft bristle brush or oil mop and dusting with a moist cloth. If the floors are thus treated there will be no damp, musty smell about the rooms and the air will be free from the dust that arises when a person walks across a carpeted floor.

FIGURE 124.
O-CEDAR OIL MOP.

Describe an excellent house floor. How should it be cared for? How can a very serviceable floor of a similar kind be made economically?

Water Supply. — Nearly every city has its water supplied by the municipal government — a more abundant, more economical, more wholesome supply than each family could provide for itself. A village of even a few hundred inhabitants should not rest content until it has installed a public water system. It will be worth many times its cost, in the improved hygiene of the home. The isolated farmer, however, must provide his own water supply. Though sometimes spring water is carried or piped to the house, most farmers rely on the well to supply house, dairy, and stable with water. This well water is rain water which filters through more or less soil and rock and takes up, among other salts, calcite (limestone), which makes it *hard.* The minerals in the water give it a slight flavor and to most of us are harmless, possibly beneficial. The problem is to keep the water free from surface pollution. Each place has its own particular conditions, but the precepts here given will usually find application.

1. Allow no drainage from the house or barnyard wastes into the well.

2. Grade the ground around the well high, so that it will slope back a rod or more from the well.

3. Lay the upper five or six feet of curbing in cement, and cement the surface back four or five feet from the edge of the well.

4. Keep a tight cover on the well at all times.

Enumerate as many particulars as you can in which the public water supply is superior to the individual family wells. How does well water come to be hard? Give rules for keeping well water pure.

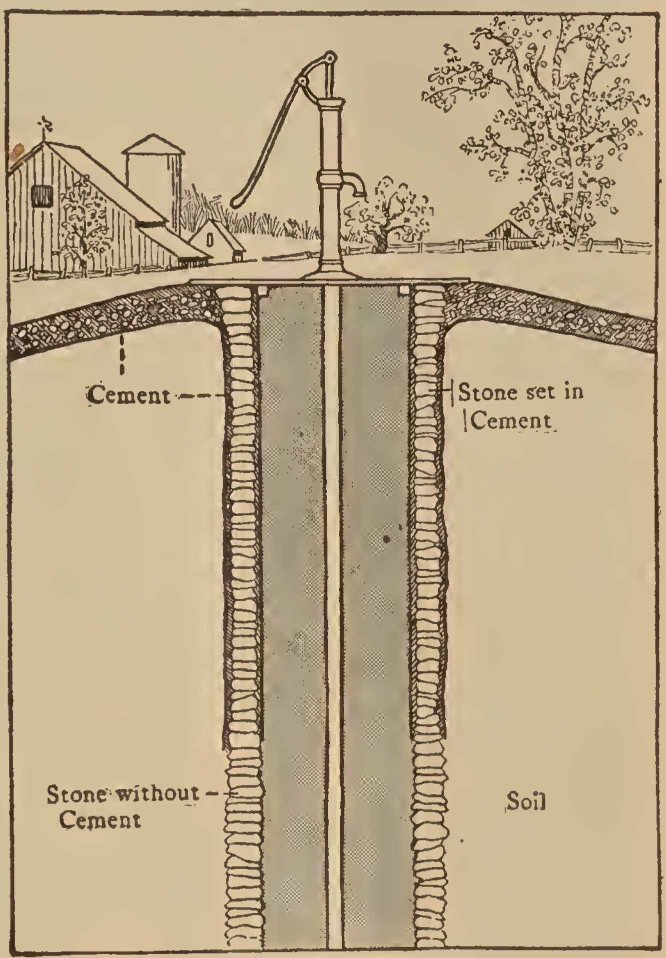


FIGURE 125. — A SANITARY WELL.

1. What advantage is there in having the cement platform slope down from the top of the well?

2. Why are the upper curb stones set in cement?

Sewage. — A city or village should establish a system of sewers at the same time it installs its water plant. Without a means of carrying off the waste water, the water supply is only half efficient and is likely to produce undrained puddles and soggy soil. The isolated farm house must have its own drain pipes. The common practice is to collect the water wastes from the house in a pipe which runs to a cesspool, a deep, covered pit. The water gradually seeps out of the cesspool if the bottom is porous, and the solids decompose. If the water does not seep out fast enough to prevent overfilling the pit, an overflow takes the clear water out at the side of the cesspool and carries it to the surface further down

the slope. The cesspool should be located at some distance from the well, preferably down the slope, to prevent its contaminating the well water.

If no such drainage is provided the waste water is likely to be thrown out by the kitchen door, making a wet soil and attracting flies. We can not be too particular about avoiding such unhygienic practices.

Explain why the full benefit of a water system can not be had without sewers. Describe a sewer suitable for a farm house. Without such a drain pipe what unhygienic practice is the family likely to adopt? What caution should be observed in the location of the cesspool?

The Rural Toilet. — The problem of the toilet for the house in which there is no running water is great. In the summer there is the ever present danger of the spread of infection by the flies. Great pains should be taken in the construction of the outbuilding to make it fly-proof. In these days of cement that is not impossible. Whenever there is an intestinal infection in the family, — diarrhea, dysentery, typhoid, — a strong disinfectant should be sprinkled in the vault. Quicklime, milk of lime, chlorid of lime or creosote is suitable. If the vault is deep a little earth, ashes, or lime will suffice.

A chemical toilet has recently come into use which is of great value in rural homes. It can be installed within the house, in the basement or in a special toilet room. The expense of the installation is not great and the cost of maintenance is small. The contents are disinfected and decomposed by a chemical agent.

What serious danger has an outdoor toilet in summer? What can be done to minimize this danger? What advantages has a chemical toilet?

The Bath Room. — There is little difficulty in keeping the bath room ever serviceable in a well-heated house where there is running water. But in a house not so equipped

FIGURE 126. — HER BACK YARD.

A village or city home with a few feet of yard space can be made a beautiful and healthful place for rearing children.

the temptation is not to bathe. There should always be some provision in the plans of a house for the bath. A

small room should be set apart for this and furnished with a little heating stove. A bath tub with a drain could be installed even if there is no running water. On regular days the room could be warmed and buckets of hot water brought, so that every member of the family could bathe. Where there is some inconvenience about the bath there should be especial care taken to train the young people in the custom of bathing so that regularity of habit will help to overcome natural inertia.

Why does the poorly heated house require especial attention to bathing conveniences? Suggest what could be done to train the children in the bathing habit.

Garbage. — The disposal of garbage in cities is discussed in the next chapter. In small villages and on farms the table and kitchen refuse is fed to the chickens and pigs. This is a good and economical use to make of it. There are, however, some precautions to be observed in handling the garbage. It should never be spilled about, for it will breed flies and attract rats. The garbage receptacles should be covered and should be *cleaned daily.* The smell from them in many farm houses is disgraceful. The feeding troughs are also likely to breed flies and attract rats. They should be kept out of the mud and cleaned when the animals have emptied them. It is not necessary that a pig-pen produce a stench offensive many rods distant.

What good use does the farmer make of garbage? What precautions should he observe in handling it?

Stable Manure. — In cities where a man who keeps horses may easily create a nuisance for his many neighbors by keeping an untidy stable, the laws provide that he must keep the premises clean, and put the manure in tight boxes, where it stays until it is hauled away. In the country, on the other hand, the farmer is supposed to injure no one but himself if his stable is ill kept, and therefore he is allowed to manage

it just as he chooses. He sometimes does not manage it well.

His manure pile is a breeding place for flies, which may swarm into his own kitchen and dining room and overflow to his neighbor's. A large part of the fertilizing value of the manure may be lost in weathering. The manure should be kept away from the flies and protected from the rains until it is hauled to the fields. Then the sooner it is turned under the soil the better. Detailed instructions that every owner of live stock ought to be guided by are contained in Bulletin 851, United States Department of Agriculture, Washington, D. C. The pamphlet may be had for the asking.

How should manure be cared for until it is spread on the field?

Flies. — We should not only take every precaution to avoid breeding flies but should also kill them whenever possible. An effective and cheap poison is a spoonful of formaldehyd in a pint of water with a little sugar. Pour it into small dishes and set the dishes where flies congregate. Fly traps are for sale in all the hardware stores. Buy or make several and set them outside the door — don't wait for the flies to come in. If you are diligent you can poison and trap nearly all the flies on the premises. The pests should be killed especially in the spring and early summer, for each pair allowed to live may have millions of offspring before the summer is over. Of course the swatter should be used whenever there is opportunity. In addition to killing the flies we should keep the premises so clean that the insects will have no place to breed. No scrap of food should be left lying around in which eggs can be laid and on which the young can feed.

Explain three ways of killing flies. What more should we do to prevent the fly nuisance?

In Camp. — The temporary home we sometimes make for ourselves in summer, the camp or the rural boarding

house, has much the same problems as we meet in our permanent homes, but with variations. We sometimes think that in vacation we may ease up on our hygienic regulations. The fact is we need to take even greater care of our health in the unusual vacation surroundings. We are more likely to be exposed to disease in such places than at home. For in the resort or camp there are not usually the conveniences for taking such good care of the food and water as we have at home.

Flies are often abundant when we have no means of protection from them. The toilet facilities are likely to be of the crudest and most unhygienic type. The swimming pools are sometimes found to be contaminated with sewage. It behooves us to investigate all these conditions when we choose a vacation place and not accept dangers which we would shun at home. There is an abundance of good resorts whose hygienic arrangements are beyond reproach. In planning our own camp we should study a good camp manual to get suggestions of ways in which a camp can be kept healthful.

Why is there need of taking particular care of our health during vacation? In what ways are summer resorts inferior in health arrangements to our homes? What is more important at a summer resort than the facilities for boating and fishing?

The School. — The following is a very much contracted form of a statement of sanitary requirements for rural schools made by a committee of doctors and teachers:

1. The school should be so situated that it is free from noise, is easily accessible, is on ground well drained and free from mud and rock, with trees, grass, and flowers and open room for play.

2. The school building, even if only a one-teacher school, should have an entrance hall, a cloak room for boys and one for girls, and in addition to the class room a small room for sudden sickness or accident, for library, for consultation, and another small room with cooking facilities and a work-bench and tools.

3. The heating should be by a basement furnace, but if by stove in the room the stove must have a *jacket*. Connected with the heating apparatus should be a ventilating scheme by which an abundance of fresh air is warmed as it enters and the air in exit taken out near the floor. The temperature should be kept at about 68 degrees.

4. The lighting of the room should be by windows at the pupil's left, with no windows in front, and at the rear and right only if they are small and high. The window shades should be translucent to admit light but not direct sunshine. Blackboards should be opposite the windows, never between them. To reflect the light the ceiling and upper walls should be light colored.

5. The best desks are individual, movable, and adjusted to the size of the pupil.

6. The cleanliness of the room should be secured by *damp sweeping* (wet sawdust, oily broom, etc.) and by dusting with damp or oily cloth and by frequent scrubbing, sunning, and airing. The pupils should have conveniences for washing before eating, after going to the toilet etc.; and individual paper towels should be used.

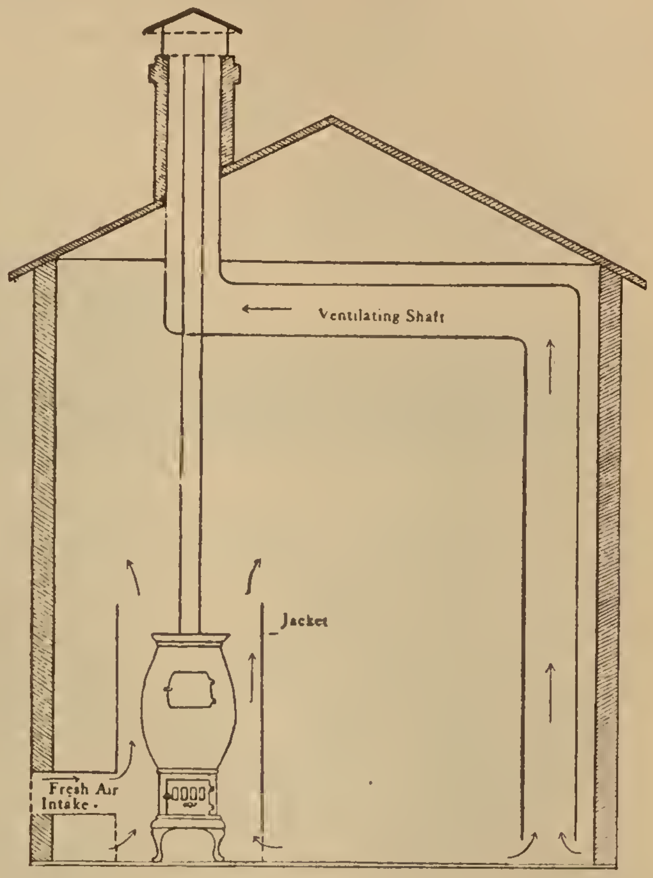
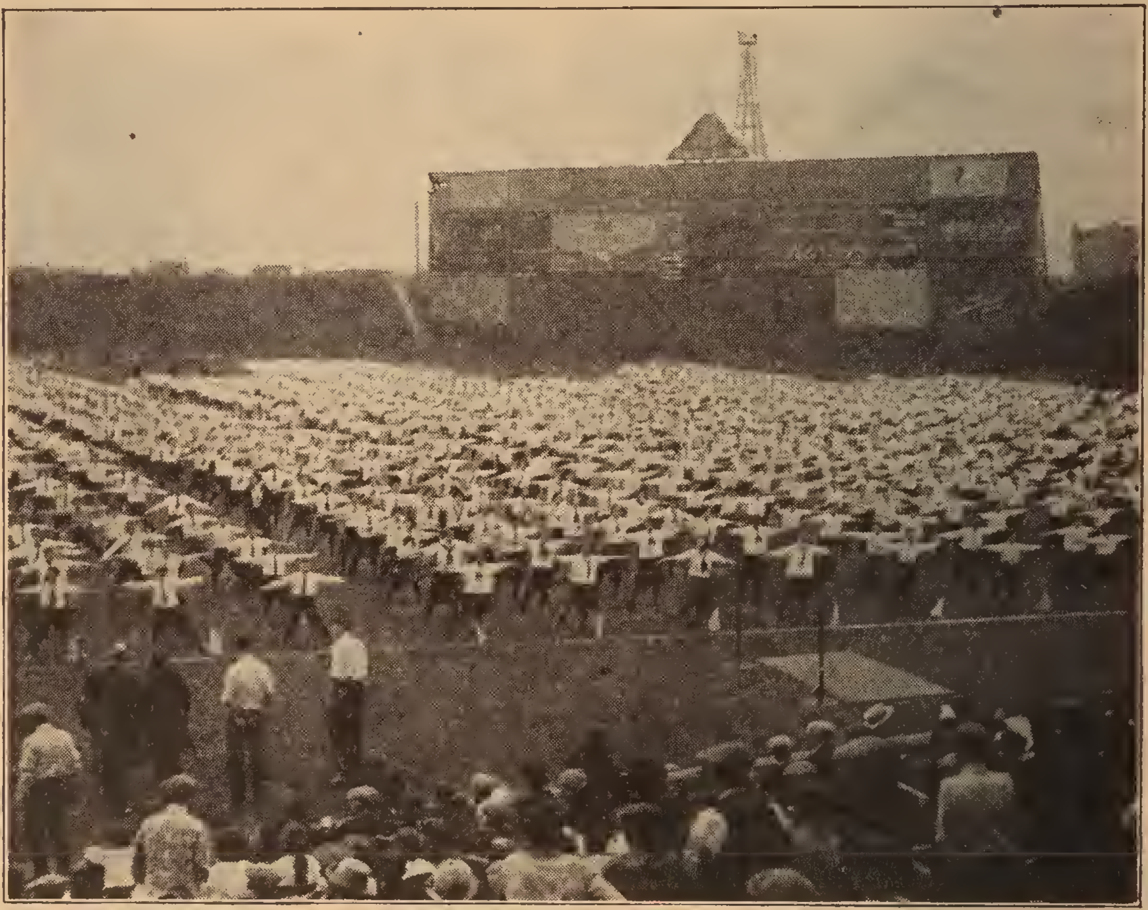


FIGURE 127. — A JACKETED STOVE IN A ONE-ROOM SCHOOL.

1. Why is there a few inches of open space between the jacket and the floor?
2. Why does the ventilating shaft reach down nearly to the floor instead of opening near the ceiling?
3. How could the air of the room easily be kept moist?
4. Why does the stove pipe run through the ventilating shaft?

7. Pure drinking water should be convenient for everyone at all times, from either a sanitary fountain or paper cups. No common cup should be allowed.

8. The toilets should be strictly sanitary, clean, free from offensive writing, and screened from flies.



P. & A. photo.

FIGURE 128. — TRAINING FOR HEALTH.

These school children are learning under the direction of a physical training instructor to stand straight and to move rhythmically and gracefully.

Unfortunately many of our schools are not provided with even these conditions, which are set forth as the minimum required. We should aim at something much better and try to convince those in charge of the schools of the need of providing for the health of the children as well as for the mind training. Each pupil should conceive the ideal of a sanitary and beautiful school and should be expected to do his share toward making his own school such a place.

CHAPTER XVIII

THE GOVERNMENT AND HEALTH

That is the best government which desires to make the people happy, and knows how to make them happy.

— Macaulay.

Individually we can do many things to keep ourselves in health, but when we have done all that we are able to do there remains much that must be done by the coöperation of all of us. Our only organized means of such coöperation is the government, municipal, state, national.

Water Supply. — In the country each family provides its own supply of water, but in the cities and large villages we coöperate, usually as a municipal government, to provide water for all of us. We citizens have no care about the water supply other than to avoid waste. We elect officers who hire engineers to look after all the details. Our concern is to elect officers who will diligently and honestly administer the work. However, it is well for all of us to have in mind some ideal of a water system and to support the officials in any improvement projected.

Nearly all the cities in the western part of the United States, from Denver to the Pacific, get their water supply from the mountains. They choose a stream high in the mountains, fence in its basin to keep out contaminating intruders, dam the outlet to make a reservoir, and conduct the water to the city mains. Often considerable power is obtained from the high pressure of the water.

Cities along the Great Lakes have an inexhaustible supply of unusually good water if they only keep it free from sewage. The cities themselves are learning to take care of their sewage; but the vessels, that ply the lakes, increasing in number, are a serious source of contamination. They must be stopped from dumping their wastes into the water supply.

FIGURE 129. — COMMUNITY SERVICE.

The wagons here lined up for inspection go through the city streets collecting the ashes, which they haul to the dump where land is being made for a city park. When the wagon is loaded a canvas is fastened over it to prevent the scattering and blowing about of the ashes.

Many small cities get their water from artesian wells. It is free from germs but is usually hard and is too limited in quantity for large communities. The large cities, like Cincinnati and St. Louis, get their supply from the great rivers flowing past. The water is muddy and contaminated with germs. It is pumped into large settling basins, where

many of the bacteria are carried to the bottom with the mud, and is also purified by chemical means. Most of the eastern cities are supplied by artesian wells or by streams in the hills or mountains. Though water of some cities is provided by private corporations, we are generally agreed that the water supply is too vital a matter to be entrusted

FIGURE 130. — GARBAGE COLLECTORS.

The garbage of Chicago is collected in tight metal boxes in which it is conveyed to the rendering plant, where the grease is extracted and the residue made into fertilizer.

to corporations conducted for gain. The municipalities usually own and manage their water supply.

Name three ways in which cities get their water supply and give examples of each. Why does the municipality usually own and manage its water supply?

Sewage. — We have allowed sewage from cities and waste from factories to pollute our streams till the fish have been killed and the water has become unfit for use and is a menace to our health. At last some cities are waking up to the fact

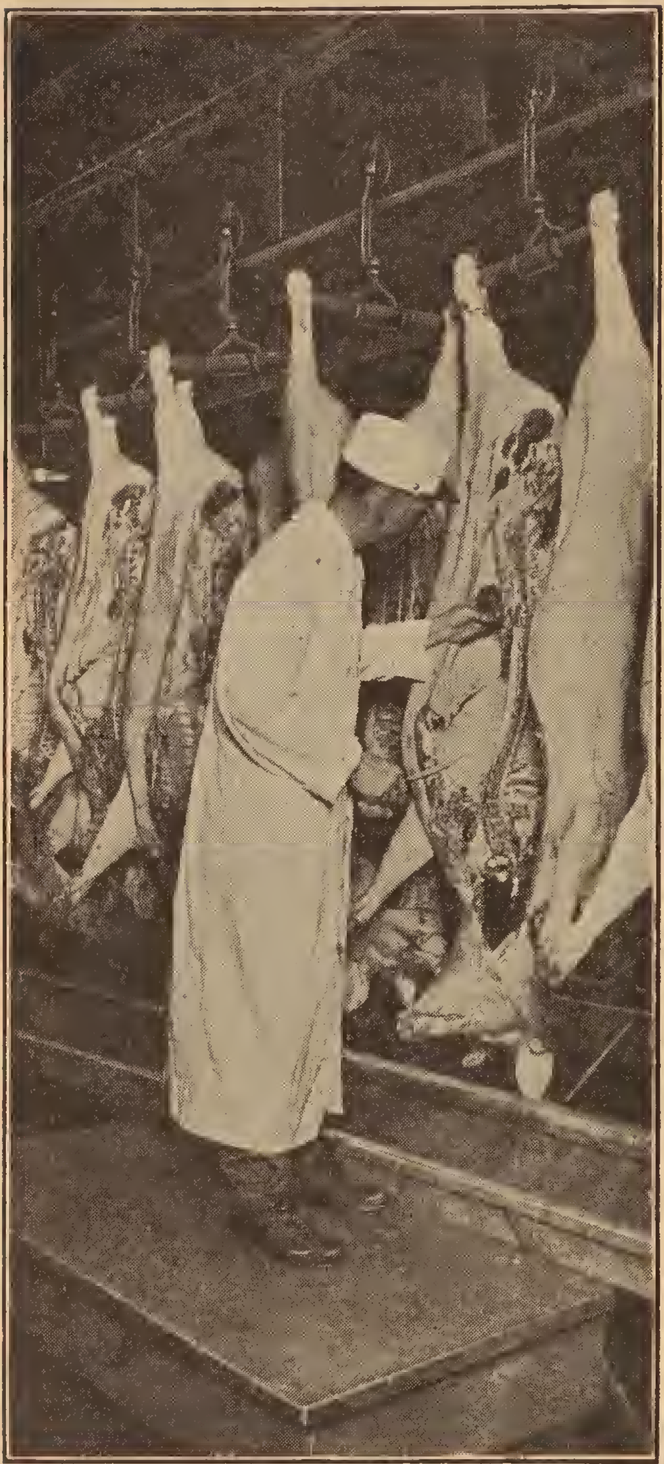


FIGURE 131. — UNITED STATES INSPECTION.

A government inspector is at work on hog carcasses. He is examining the kidney. There are various glands throughout the body which give early evidence of disease. Knowing the locations of these glands, the veterinarian cuts into them to see if they are sound, thus assuring the wholesomeness of the meat.

that this pollution of the streams is unnecessary. They are pumping their sewage into large settling basins. The sediment is a valuable fertilizer. The water is not only clarified but also purified and turned back into streams which have become once more alive with fish and are beautiful places for recreation. There is no excuse for our continuing the dirty, wasteful system of throwing our fertilizer away and making vile the waterways which would otherwise be beautiful. The duty of every man, woman, and child is to demand such a disposal of our sewage as will be sanitary for the whole country as well as for our own immediate neighborhood.

Garbage is salvaged in our best-managed cities, *i.e.*, it is turned to a profitable use instead of being thrown away. The fat in it is extracted and the residue used for fertilizer.

What is the common method of disposing of city sewage? What harm results from this? How should it be treated? What good use of garbage is made in large cities? Why do city ordinances require garbage and ashes to be kept separate?

FIGURE 132. — THE STAMP OF APPROVAL.

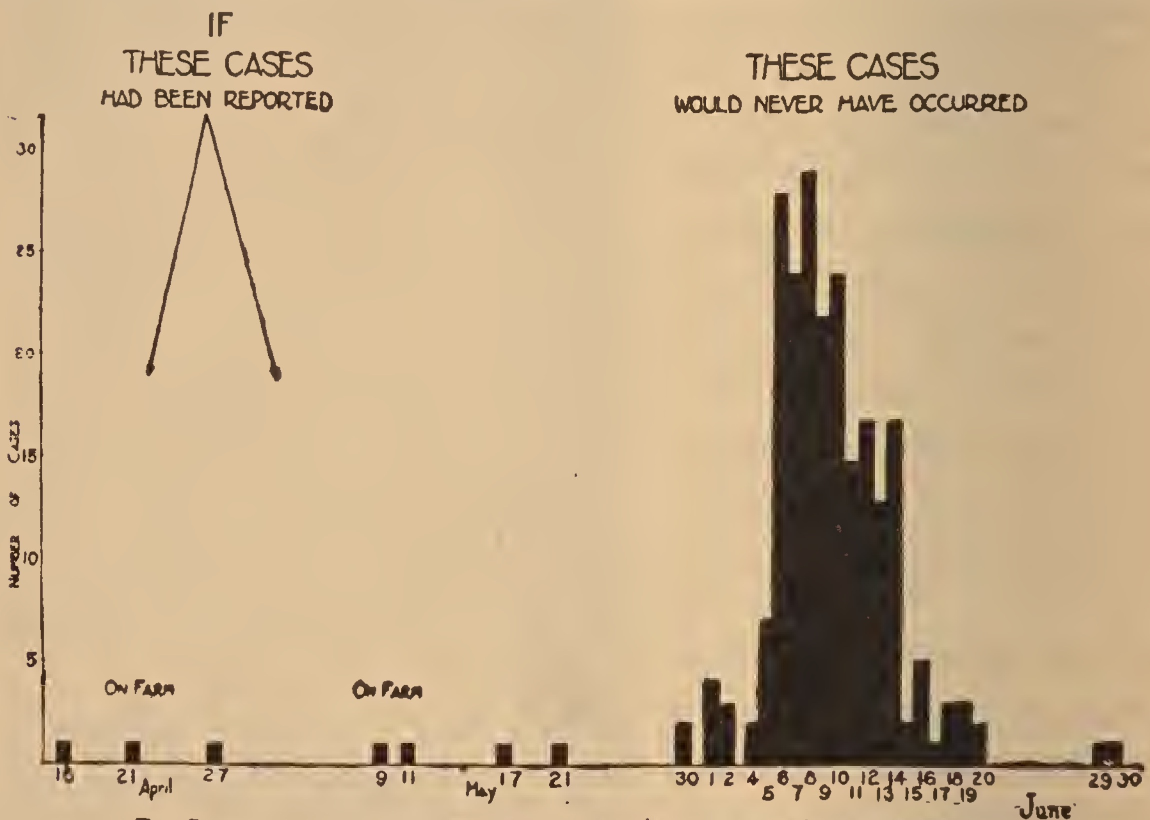
A government official is stamping a beef carcass which has passed all government tests and whose wholesomeness is thus assured.

Food Inspection. — When people grow their own vegetables and fruit, raise their own chickens, butcher the calves and pigs they have fed, they are their own food inspectors and can see that only wholesome products come into their kitchen and go on their table. But when our fruit comes from Michigan, our chickens from Texas, our pork from Iowa, our beef from Colorado, our lamb from Montana, and a dozen other things from a dozen other states, we need government inspectors to watch the stockyards, and municipal inspectors to watch the storehouses and retail markets so that only wholesome food is offered for our use.

The inspection at its best is superficial. The force of inspectors, if it were twice as great as it is, could not examine all the food that goes through the packinghouses and commission markets. And it is not necessary that everything

should be carefully inspected. Nearly everything handled is in good condition, and much of that which is bad can be so easily detected that customers will not take it.

Yet our pure food laws and inspectors are indispensable and we should make it possible, by larger appropriations, for them to do their work more thoroughly. So long as our



THE STORY OF THE EPIDEMIC OF SEPTIC SORE THROAT AT ROCKVILLE CENTRE, L. I.

FIGURE 133. — SORE THROAT.

A few cases of severe sore throat occurred on some dairy farms. The milk produced on these farms became contaminated and carried the germs to city customers, many of whom contracted the disease.

economic organization rests on the principle that the desire of greater profit is the best incentive to business, we shall find it necessary to watch the eager dealer to see that an overweening desire for profits does not lead him to defraud us even to the degree of endangering our health and lives.

In the stockyards one of the most valuable services of the inspectors is to see that no diseased animals are slaughtered for food. They should be made into soap and fertilizer. Parts of the carcass of the animal butchered are inspected

while it is being cut up, to see that it is free from parasites. Inspection is made of the cured meat to see that foods and package articles are correctly labeled. A large number of inspectors are kept busy checking up on these productions to insure honest dealing and to prevent the use of unwholesome preservatives.

Cold storage plants are visited to see that nothing spoiled is kept for the market. If the inspector finds rotten fish or poultry or meat he pours kerosene or a colored liquid over it to insure its being sent to the waste factory instead of to the market. It is impossible even to list here the services of the food inspector. They would be greater if we supported the department more generously.

Why do we need food inspection, while our fathers did not? How do our methods and ideals of business tempt dealers to handle unfit food? Name as many particulars as you can of the inspector's work. How does an inspector make sure that the food he condemns does not get to the market?

Building Regulations. — After food comes shelter. In the cities where we crowd one another and live in buildings owned by others we need protection against buildings which are unhygienic or which endanger our lives. So we have building ordinances insuring some degree of protection from fire providing for light and air, requiring sanitary sewerage and safe lighting. The buildings in which the well-to-do live are well constructed and have every provision for safety, cleanliness, light, and air.

But the buildings in which the very poor are quartered are commonly in a wretched condition, dilapidated, dirty, dark, infested with vermin and disease germs. Their owners fight every ordinance for improvement, because it would mean less profit to them. They are the friends of the lawmaker and often have things their way. Infectious diseases often start in the unsanitary tenements and spread to the better-to-do neighbors. For their own protection, as well

as because the poor are weak and need their help, those better off should insist that unsanitary dwellings be torn down and buildings fit for self-respecting citizens of the community be put up in their stead. The ideal should be good housing, not the utmost profit.

Village and rural homes are often far from what they should be, but their shortcomings more often arise out of

FIGURE 134. — CROWDED.

In this basement room, $6\frac{1}{4}$ by 10 feet, a man, his wife, and five children sleep; a condition of wretched housing which ought not to be permitted in any city.

ignorance and poverty than out of greed. Where ground is plentiful and light and air abundant, the house room is sometimes cramped, the ventilation poor, and the light bad. Worse are the sanitary provisions of bath and toilet. But the ideals of better dwellings are taking hold in the country as well as in the city. As fast as education prevails, the work-

ers in shop or on the land are demanding and getting homes in harmony with higher standards of life.

Why is it necessary that the government establish building regulations? Why are the ordinances so often imperfect and so poorly carried out? Why is it everyone's concern that the poor be decently housed? Why do rural homes so often lack the essentials of good dwellings? If you are acquainted with village or country homes point out as many particulars as you can in which they fall short of what they might be within reasonable expense. Point out the unhygienic conditions of any city residences you know.

FIGURE 135. — A HEALTHFUL HOME.

This inexpensive home in a suburb expresses good ideals of light, air, and beauty of surroundings.

Hospitals and Sanatoria. — The hospital, built for the purpose of caring for the sick, has conveniences which can not be had in our private homes. Nursing can be more economically done there. A doctor is always at hand in case of emergency. The operating rooms are scrupulously clean. We recognize the value of hospitals by establishing them in every city. There are private hospitals for those who are able to pay for their services and there are public hospitals free for those who need them.

In some places there are separate hospitals for cases of certain infectious diseases. It is especially desirable that we should take to the hospital cases of diseases which are to be quarantined. A case of diphtheria or scarlet fever or measles in the home endangers the other members of the family and interferes very much with the activities of the

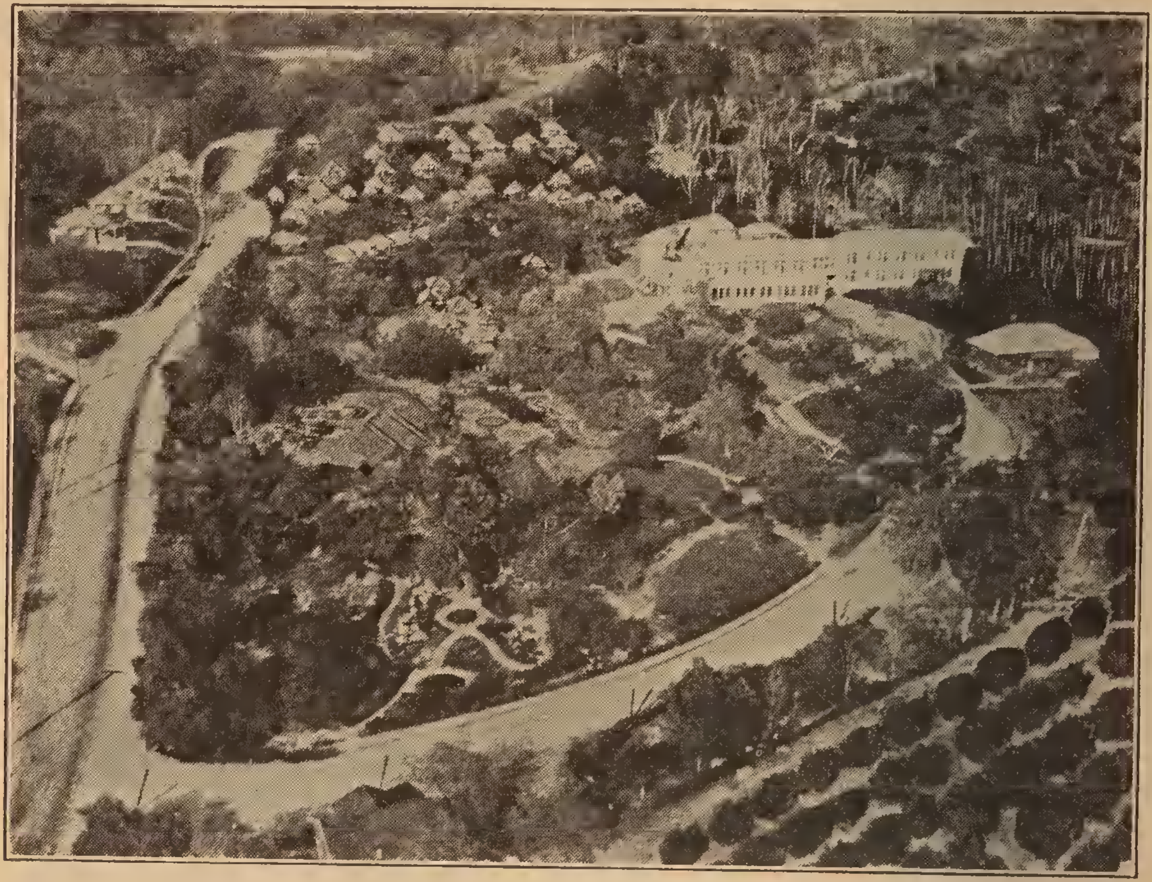


FIGURE 136. — A FRESH AIR HOSPITAL.

This is an aëroplane view of the Pottenger Sanatorium of Southern California. The many small bungalows would lead you to infer that the sanatorium treats what kind of cases? In the main building, besides the parlors and dining room, are offices, consulting rooms, and private rooms for patients. In what particulars would a patient receive better care in such a sanatorium than in his private home?

household. In the hospital it can be better cared for and the members of the family can go on about their work with no interruption.

Tuberculosis spreads from one member of the family to another because the sick one stays at home and infects those

near him. If he were in a sanatorium he would be taught to avoid spreading his disease and would have a better chance of getting well. There are people in every community who are not bedridden and yet, because of disease or injury, are unable to work and are a burden and often a menace to others. In a sanatorium they would be well cared for and would leave their friends free to work.

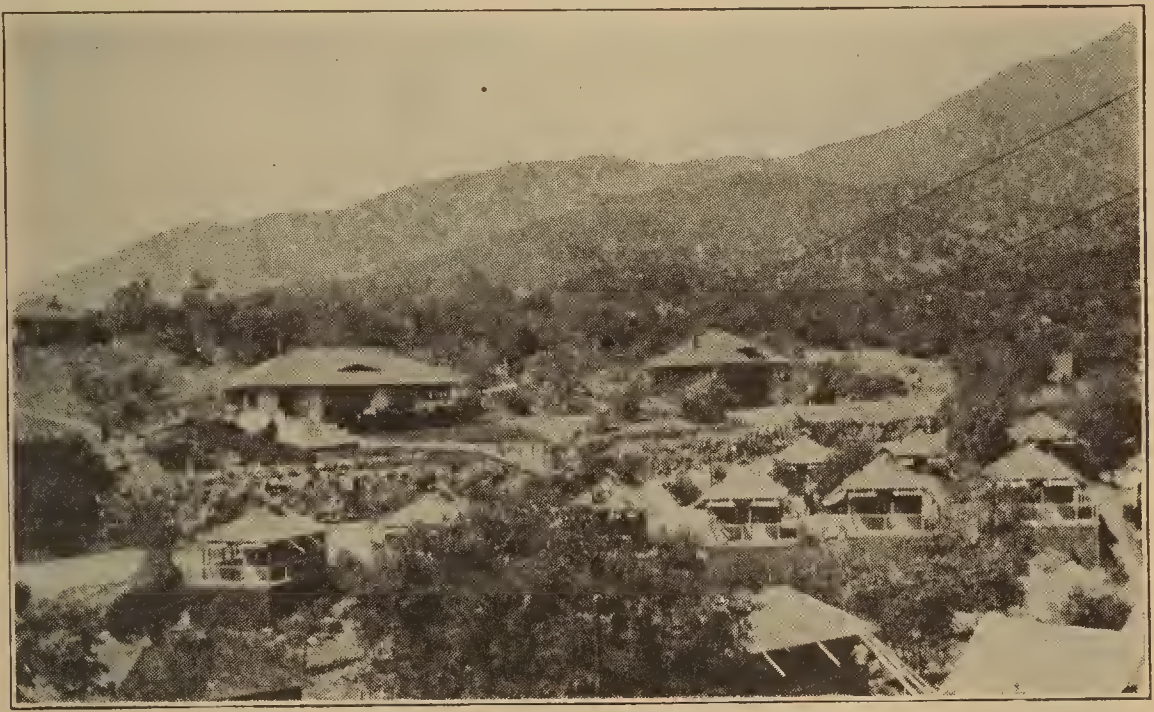


FIGURE 137. — HOMES FOR HEALTH.

A view of a few of the bungalows of the Pottenger Sanatorium in Southern California. Just behind the point of view is the main building containing the dining room and parlors, offices, and private rooms for patients. What advantages superior to those of a common home would such a sanatorium offer to patients suffering from lung disease?

The spread of infectious diseases would be very much curtailed, the recovery of the sick would be more rapid, and the energy of the workers more economically used if we made a practice of caring for the sick and disabled in hospitals and sanatoria. Those who are able to pay should be allowed to choose such accommodation as they wish, and pay for it. Those unable to pay should be taken as the guests of the community and given the best of care as a measure of welfare to the whole community.

Why can the sick be better cared for in hospitals than in private homes? Why should cases of infectious diseases especially be treated in hospitals? What can a consumptive do to safeguard members of his family? Show that it would be a measure of economy to the community to provide hospital and sanatorium care for its members.

Health Centers. — We are beginning to recognize how ignorant most of us are about hygiene and how much can

FIGURE 138. — BABY DAY.

To this rural "health center" supported by public funds mothers bring their babies for advice and instruction in their care, — feeding, bathing, dressing, etc. On other days the doctors and nurses meet older patients.

be done for us by a little instruction in caring for our health. Therefore some state and some municipal officers are maintaining stations where doctors and nurses give advice and help to those who come. Mothers are instructed about feeding and bathing and dressing their babies. Ailing or underweight children are examined and their parents advised about their care and nourishment. The tuberculous are taught how to take care of themselves to promote their recovery and avoid infecting others. Children growing up crippled by infantile paralysis are treated and at least a

partial use of their limbs restored. In times of distress pure milk for babies is given to those who can not buy. But most important of all are the lessons in health which the visitors

FIGURE 139. — MEDICAL INSPECTION.

The school doctor is testing the chest of this anemic girl to see if her lungs are sound.

receive with the personal admonition of the doctors and nurses in charge of the center.

Why have some state and some municipal officers established health centers in the community? What is done for the people at

the health centers? Where there is no health center do the people do without this serivce, or do they procure it in some other way?

Medical and Dental Service in Schools. — The spread of infectious diseases in school, the low physical condition of many children and the deplorable state of their teeth have

FIGURE 140. — MEASUREMENTS.

The school doctor measuring and weighing an undernourished boy.

compelled us to bring the doctor, the dentist, and the nurse into the school.

In some schools the doctor makes only a partial examination of pupils who have been absent or who have been ill, to determine whether they may continue in school without menacing the health of others. In some schools the doctor makes a careful examination of every pupil who seems not to be in good health and advises the parents about the care

of the child; about operations needed, such as the removal of adenoids and tonsils; and about defective vision or hearing.

The nurse, with the parent's consent, takes the child to the surgeon for operation or treatment, or to an oculist for eye examination. The nurse goes to the home to urge the parent to carry out the directions of the doctor or the dentist, as well as to visit sick and absent pupils.

The school dentist commonly examines the children's teeth and sends a written statement of their condition to the parents, with a recommendation for treatment. In some schools, however, the dentist is employed at public expense to do the work needed on the children's teeth.

The medical, dental, and nursing work done in the schools has resulted in very great improvement in the health of the children. It should receive more generous support so that it can be more thoroughly done.

For what reasons are doctors sent to inspect children in school? What is the minimum service the doctor renders, intended only for the protection of the healthy children? What more extensive service is given in some schools? State the common work of school dental inspection. What more does the dentist do in some schools? What does the nurse do to double the effectiveness of the doctor and the dentist? Do you think the doctor or the dentist or the nurse could have been of any service to any member of your class within the last week?

Quarantine. — In many diseases we keep the sick away from those who are well, that the latter may escape the contagion. The precaution is quite unnecessary in some diseases. Yellow fever and malaria are carried by certain mosquitoes only, and so the patients should be quarantined by screening. People can visit such patients without danger. Visitors are not usually excluded from the rooms of those afflicted with intestinal infections.

We quarantine cases of disease which affect the throat, lungs, or skin, because the germs of these diseases are more likely to be communicated to people coming near. A cough

or a sneeze throws germs from the nose or throat into the air several feet away — to be taken up by the visitor. A case of smallpox is usually removed from the home and quarantined in special hospital or isolated house.

FIGURE 141.— GUARDING THE THRESHOLD.

These officials are inspecting immigrants at Ellis Island to make sure that no infectious diseases are brought in.

Flies may get germs on their feet and carry them to other people. So it is very important in quarantining to shut out the flies.

A quarantine at a port of entrance to a country is more strict than a house quarantine. Every communicable disease which is not already prevalent in the country must be stopped at the gates.

Quarantine is sometimes a great inconvenience to people. By its provisions in some diseases (diphtheria, scarlet fever) well people who are living in the same house with a case

of sickness may not go to their work. If we should give hospital care to the sick it would remove this inconvenience. We are usually too slack about observing the rules of quarantine. The rules were made to protect those who are well. We should all consider it our patriotic duty to abide strictly by the quarantine regulations. Every time we break a regulation, we endanger the health of others. Breaking quarantine is a punishable offense; it is treason to our community. One who wantonly gives a disease to another is a traitor.

What is the purpose of quarantine? What sort of diseases are quarantined in the home? What sort are not? How is smallpox usually quarantined? Why is a quarantine at a port of entrance much more strict than a house quarantine? How could we avoid the inconvenience of house quarantine? How will conscientious people regard quarantine?

Animal Pests. — Rats and mice and flies destroy hundreds of millions of dollars' worth of food in our country every year. More than that they are the agents by which disease germs are spread. We ought to exterminate the pests. When the bubonic plague appeared in San Francisco in 1900 and it was known that the germs were carried from one person to another by fleas, and that flea-infested rats carried the plague from house to house, the city authorities and even surgeons assigned by the United States government gave their attention to catching the rats. And a good job they made of it, too. They taught us that it is possible for us to free ourselves from these pests if we go at it seriously. But it is not a campaign in which an individual can accomplish much alone. We must all coöperate.

Our government is organized to do the work which needs the concerted effort of all the citizens. Every municipality should make a campaign, a continuous warfare against vermin of all sorts. Flies, mosquitoes, rats, and mice could be reduced to such an insignificant number that they would

not annoy us, and we should be in better health and get more satisfaction out of life. It would require only a well-directed warfare and adequate support.

Most of these pests are worse in the country than in the city. And there the extermination of them depends more on

FIGURE 142. — THE PAPER BURNER.

This man goes through the streets and alleys picking up and burning in his iron cage the papers and other light combustibles which litter the way. A city which is not neat will not be sanitary.

the efforts of the individual. If the farmer would once get the idea that he does not need to pay a heavy toll of his crop to the rats, that breeding flies is not a necessary part of farm activity, he could find ways of getting rid of the pests. It would require some thought and attention and a little increased expense in building. But it would richly repay all it cost. Farmers' Bulletin No. 896 and Bulletin No. 33, Biological Survey, ought to be in the hands of every farmer and of every city householder too.

Make a list of as many pests as you can that are known or suspected of carrying disease germs. Why can we not free ourselves from them by our individual effort? What reasons have we for thinking that government action would be successful? Could the government accomplish much without the general support of the citizens? How is the rural problem different from that of the city? What is your duty in the matter?

Nuisance and Worse. — We commonly think of smoke, dust, vile smells, and noise as nuisances. They are, but they are worse than mere sources of annoyance. They impair our health so insidiously that we do not notice it. Sanatoria are built in the country where it is quiet, where grass and trees prevent flying dust, where the air is pure and invigorating. All these desirable things are just as good for us who are working every day as for those who are recuperating in sanatoria.

Our industrial life has been so completely devoted to making money that we have overlooked the end of it all — wholesome living. True we have smoke inspectors whose labors have changed the pall which hangs over the city to a lighter gray. Some of our streets are kept fairly free from dust. If some of the offensive smells have been abated others as bad have taken their place; and the noise is worse.

Of course we can not free our labors from everything offensive, but when we are subject day and night to the nuisances that blight our lives, that make our children's complexions sallow, it is time to think of the ends of living. Is the profit of the industry worth the life it costs? Should we not have a better community, more diligent, more appreciative of beauty, more devoted to justice, if we freed our homes from the depressing nuisances which we have allowed our industries to impose? The means can be found if we have the ideal strong in our minds; if we make the demand.

How does smoke harm us? How does dust injure us? There are no disease germs in bad odors; how can they affect our health? What harm is in noise? How can the smoke nuisance be abated?

Can we have industry without smoke and poisonous gases in the atmosphere? What nuisances have you observed in your neighborhood? What could be done to decrease or abolish them? Why must the government intervene, why not let the individual citizen deal with the nuisances?

FIGURE 143. — CLEAN THE STREETS!

This "power flusher" is designed not simply to lay the dust; it throws out a sheet of water with such force as to wash much of the dirt from the middle of the street down into the gutter, where it is swept up and carted away. Clean streets promote health.

Protection for the Workman. — For many years there has been a growing, and lately a rapidly increasing government regulation of industries, to give protection to the workman. The number of hours which constitute a day's work has gradually been cut down, partly through government action. It was once fourteen or fifteen, then twelve, ten, nine. Now eight is generally recognized as the fair number, with a shorter day for unusually hazardous or strenuous occupations. Machinery must be guarded. Poisonous

fumes and gritty dust must be drawn away from the workman by ventilators. Unnecessary poisons (yellow phosphorus) must not be used. When poisons are used workmen must be cautioned how to protect themselves. Toilet facilities must not be overcrowded.

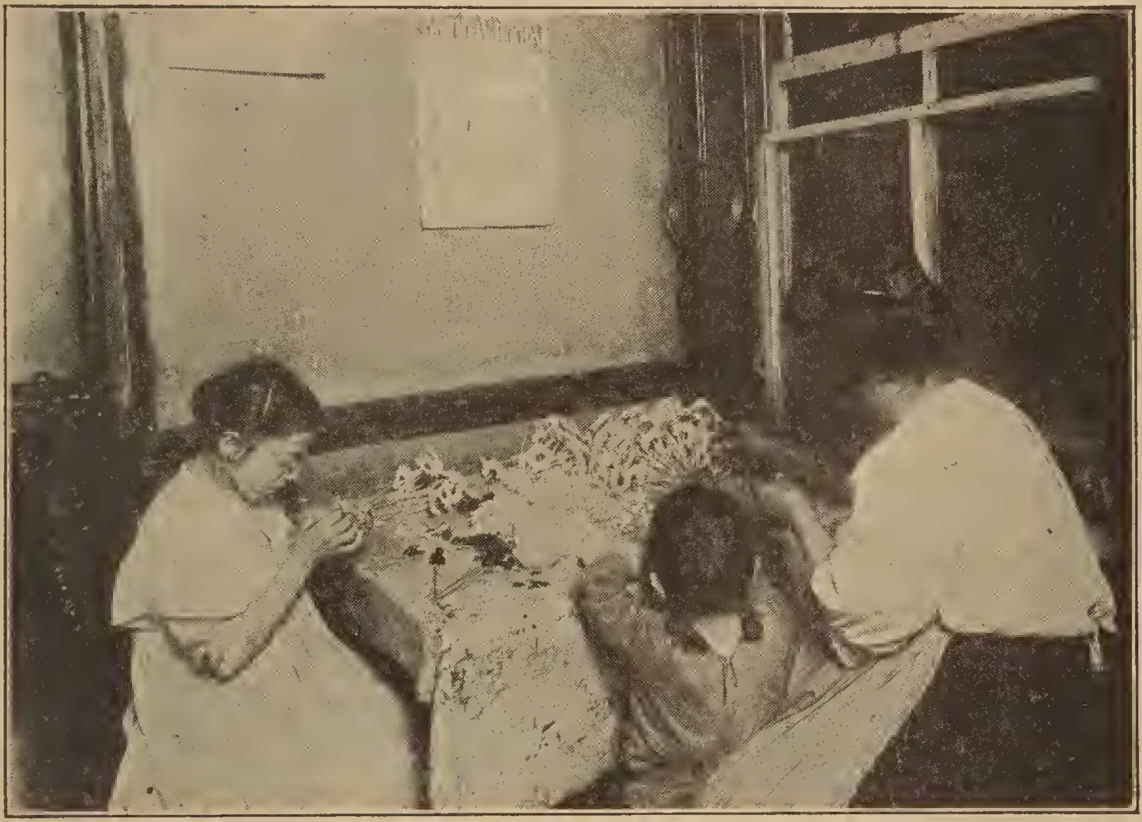


FIGURE 144. — DRUDGERY THAT DESTROYS.

Thirteen-year-old Mary, whose eyes are in bad condition, has to work evenings on artificial flowers. One of the worst features of "sweated" work is that the children can not be protected from its harmful effects.

Neither women nor children should be employed at night nor at certain hazardous occupations. Only a few years ago children as young as six or eight years old were worked all day in factories. The age limit has gradually been raised till now sixteen is the generally recognized minimum, though some states lag behind.

All these government regulations aim at conserving the workman's health and life. They are abundantly justified by their results. Children are in school, building up their minds and bodies instead of wearing their lives away in the

tending of machines. Women are better mothers and better home makers because they are not dragged down by exhausting labor. Men have more leisure to live and to learn how to live. They are more upstanding citizens.

Yet much remains to be done. Arms and eyes and life itself are still too cheap. Certain kinds of business are simply machines for turning out profits, and in them the workman's life is worn out by grinding toil or snuffed out by sudden accident. The health of the worker will not be properly conserved until we put human life ahead of profits and make the end and aim of all industry the maintenance of strength, the increase in skill, the development of mind.

FIGURE 145. — CHILD LABOR.

This boy of a well-to-do family is made to work when he should be in school. The knife with which he tops the beets is a dangerous tool for a young boy.

Why should the worker need special protection? Name as many ways as you can in which the government has protected him. What have workmen in voluntary organizations done to protect themselves? What good results can you notice from government regulations in industry? What can you do now for the health of the factory worker? When you grow up if you become a workman, what will you do for your own protection? Do you know of any protective regulations for rural workers?

Recreation Centers. — Many cities have made extensive provision for the recreation of their citizens, — none too much. Rural communities are catching the idea and by voluntary organization or by official action are inducing people to use their leisure for the improvement of their bodies

and minds. Parks, playgrounds, bathing beaches, public gymnasiums, camps, forest preserves, boats, play directors, competitive games, — all are provided by public funds to encourage people to make their recreation a wholesome, health-giving influence.

FIGURE 146. — FILLING IN.

The wastes of the city which do not decay and become offensive, the ashes, earth, and stone, are dumped into the lake to make the foundation for a park. This rubbish will be covered with soil. Then shade trees, grass, and flowers will make a beautiful spot where the city dwellers will come to enjoy the fresh, pure air from the lake.

The temptation to the public official is to make a show thing rather than a thing of service, — a park with a fine landscape effect and elegant buildings, a place to be enjoyed by one bowling through in a fine car or cantering along the saddle path. Beauty of landscape is desirable, but the health of the men from the shops and factories and offices and of their families is the first consideration. The recreation place must be easily accessible. Therefore there

should be in a large city many small parks with play apparatus for children, with tennis courts, with open spaces and benches in cozy nooks. No large park can equal these for service. And these small parks must be under the supervision of attendants who sympathize with their purpose and will try to make them serve the needs of the community.

FIGURE 147. — A PUBLIC PLAYGROUND.

Is there any good reason why every city, large or small, should not have such a play place?

Of great value are the outlying parks also, like certain forest preserves, in which a troop of boy or girl scouts can build a fire and cook supper or camp for a day or two. Here are opportunities for boating and swimming, for skating and skiing; ball fields and conveniences for group picnics; quiet paths for bird lovers, and secluded nooks where the friend of flowers can find his silent acquaintances.

What recreation centers are there in your neighborhood? What others have you visited? Why are a few small parks more serviceable than one large park? Do you know of any place where you

and a company of friends would be welcome to camp? Where could you go for a picnic? In winter is there a swimming tank or a gymnasium accessible to you?

Licensed to Practice. — In its work of safeguarding the community the state government has established certain regulations for those who administer medicine. Druggists,

FIGURE 148. — A LAKE IN DEER PARK, COOK COUNTY (Chicago).

Hundreds of acres have been bought by the county commissioners, that the trees may be preserved and the land kept as a recreation ground for the citizens.

dentists, and physicians, before they are licensed to practice, must have had certain educational qualifications and also must pass an examination given by the state to prove that they are qualified to do the work they undertake. The state boards of examiners, who are authorized to issue the licenses, have gradually raised their standards until now in most states a license to practice is evidence that its holder has had good training.

In choosing a doctor we should be governed not so much by the social qualities of the physician as by his professional ability. The doctor to whom his fellow practitioners go for

advice and help is pretty sure to be unusually able. When we have made our residence in a neighborhood we should try to learn (not from Tom, Dick, and Harry, but from discriminating people who have facts behind their opinion) of an able and trustworthy physician. Then when we have need of medical service we should go to him and follow his directions. It is poor policy to run from one doctor to another, or to think nothing about a physician until the need is urgent, then take the first one that appears.

In nearly all large cities there are a few renegade doctors, or charlatans, who prey upon ignorant sufferers. They advertise "to cure where others fail," "no cure no pay," "specialists for men," "nerve specialists," etc. They are unscrupulous frauds who do the community great harm. Sometimes one is arrested and punished for illegal practice, but usually they hold a license to practice medicine and are sufficiently crafty not to violate the letter of the law. Reputable physicians do not advertise; avoid one who does. Any physician who advertises is *below* the average in his profession.

Besides the regular, licensed physicians there are other practitioners; such as Christian Scientists, osteopaths, chiropractors, naprapaths, etc. There is no law against their practicing their arts or their beliefs, but unless they pass the examinations and receive a license they have not the same legal standing as physicians. A licensed physician may practice any of these arts if he likes. The laws do not prescribe any method of treatment; they only try to provide that physicians shall receive adequate preparation for their work. Most of these other practitioners are not licensed physicians but in some states do hold a license permitting them to practice within the limit of their cult.

What assurance have we that a physician is well trained in his profession? How can one know what physicians are unusually capable? How can one tell what "doctors" to avoid? Why

is it advisable to choose a family physician before his services are needed? Is there any law forbidding healers of various cults to cure disease? How is the regular physician's standing in law different from that of the irregular practitioner's? How can any practitioner acquire the legal status of a physician?

"**Patent Medicines.**" — There are certain concoctions sold under more or less fancy trade names and intended for

FIGURE 149. — A SCHOOL PLAYGROUND.

How much better for the children to be here than in the street! In the five years preceding 1920 about two thousand children in the United States were killed by automobiles, and the number is increasing.

use by the sick without a physician's prescription. The sick man is to be his own physician, diagnose his own ailment, and cure it by using the "patent medicine." The "patent medicine" is supposed by the unwary to be a secret preparation containing especially valuable drugs, whose curative properties the manufacturers have discovered and which they are glad (for a small financial consideration) to give to their suffering fellow-men. The facts are, the ingredients of these medicines are known; they are common

drugs, many of them long since discarded by physicians as having been weighed in the balance and found wanting.

Many "patent medicines" contain a high per cent of alcohol, and owe their reputation as "repeaters" to this drug. The prohibition officials have in some instances — not all — compelled the manufacturer to reduce the quantity of alcohol previously used, but there are still many on the market having an alcohol content of from ten to twenty-five per cent — as much as some champagnes and whiskies. Drugs which are beneficial when taken according to the physician's prescription are sometimes very harmful when used too frequently or in too large quantities, — as they commonly are when the patient administers them to himself in "patent medicines."

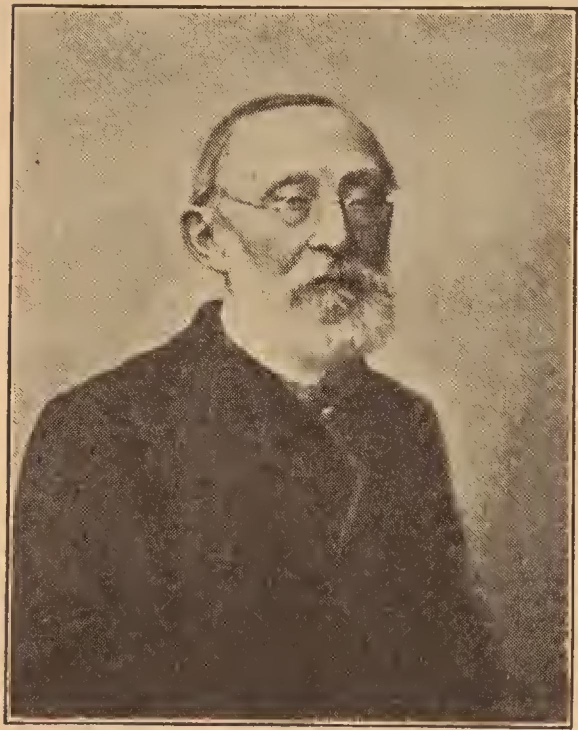


FIGURE 150. — RUDOLPH VIRCHOW, 1821–1902.

He was one of the recent great scientists whose profound studies into the nature of disease set some of the foundation stones on which the modern science of medicine has been erected.

The testimonials to the great virtues of "patent medicines" are, as evidence, wholly worthless. Many of them are written by sincere people whose minds are utterly incompetent to judge the medicine fairly, and a few of them are fraudulent — written in the advertising department of the manufactory.

One of the worst things about the habitual use of "patent medicines" is that the user gets to thinking in a morbid way about himself. He is always thinking that something is the matter with him and is looking for symptoms of disease.

He usually finds them and proceeds to take the dope recommended. If he did not have the "patent medicine" habit he would not imagine himself sick and would be a happier and more efficient worker.

The use of "patent medicines" often has the disastrous effect of substituting a worthless drug for efficient medical attention. Some diseases (notably cancer) can be cured

FIGURE 151. — CAMP FIRE GIRLS IN A PUBLICLY OWNED "FOREST PRESERVE."

Cook County (Chicago) has hundreds of acres of such meadow and forest land with brooks, rivers, and lakes where groups of girls and of boys are permitted to camp.

when taken in their early stages, but are almost or entirely hopeless when neglected until they are well developed. "Patent medicines" tempt one to neglect the doctor's aid until it is too late. The same objection applies to consulting inefficient healers of any cult; it often puts off the services of a skilled physician until it is too late.

What do we mean by a "patent medicine"? How is a sick person to tell what kind of medicine to use and when to use it? Of what are "patent medicines" composed? What ingredient has been a feature in many of them? How can one be harmed by using a "patent medicine" composed of beneficial drugs? Why are not the testimonials sufficient evidence that the medicines are good? Into what unwholesome state of mind is the user of "patent medicines"

betrayed? Why is it said that one who treats himself has a fool for his doctor? What danger is there in trying out a "patent medicine" or a new healer for a while before consulting a doctor?

A Healthy Race. — What we are when we start in life's race is what our parents endow us with — our physical inheritance. To a few are given bodies of excellent form and structure, true in every part, and minds clear and well balanced. Most of us have inherited handicaps, — defective eyes, fragile teeth, weak lungs, thin muscles, unstable nerves. We must take ourselves as we are and make the best we can of the material we have. But society can do more than that for the next generation. It can give them better heredity by choosing their parents with more wisdom than our fathers showed. The feebleminded, the invalids, the insane, marry and pass on their imperfections to their children. No one knows how great is the weakness of our race due to bad heredity. But it is enormous.

Why should we not all have native qualities as good as the best third of us? Because we breed so largely from the worst third. We must stop breeding from the poorest stock and increase reproduction of the best. This will have to be accomplished largely by the voluntary choice of individuals. If one is strong of body and sound of mind he is fit for parenthood and should accept the privilege. If one has a strain of insanity in his family, if he has epilepsy, severe tuberculosis, or any of half a dozen other weaknesses which would render his offspring defective, he has no right to have children. We should take pains to teach this to all who are intelligent enough to understand it, and to establish a public sentiment to help enforce it in society.

But outside the sphere of self-controlling intellectual people lies the group of feebleminded. They are often strong of body though feeble in mind. Still their physical defects are numerous. They reproduce abundantly, and perish in large numbers because they have not the intelli-

gence to take care of themselves. They are a growing menace to the race. They intermingle with the better stock and contaminate the whole community with their feeblemindedness. They can not control themselves. Therefore the government must take charge of them.

The most feasible scheme seems to be for the government to segregate the feebleminded men in one community and the feebleminded women in another and put them under guardians. Their conditions of life should be as nearly normal as possible. They should work reasonably and have plenty of recreation, but child-bearing should be altogether prevented. With feeblemindedness and the other sources of hereditary weakness shut off, our race might well hope to overcome a large part of the ailments which now beset it and become a race of healthy men and women whose lives are joyous because they are the normal activities of perfect bodies.

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